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ABSTRACT

This guide represents the final experimental version of an extended pilot project which was conducted in the United States between 1973 and 1976. The manner of presentation and the pedagogical ideas and tools are based on the works of Georges and Frederique Papy. They are recognized as having introduced colored arrow drawings ("papygrams") and models of our numeration system (the Papy "minicomputer") into the teaching of mathematics at the elementary and secondary level in Belgium. The CSMP curriculum follows the "spiral approach." The guide emphasizes that a topic may provide children with intuitive leaps which might help them acquire successive pieces of information. Suggestions are presented to the teacher for obtaining and preparing materials for lessons. The list of materials is organized into those available and those not available from CSMP. The text of the guide is divided into four sections. The first is an open letter to the teacher in which questions most frequently asked are answered. The next section is a set of ideas on how to develop a good numerical environment and a variety of quick number activities for daily use. The Day-by-Day Guide, section three, contains 108 lessons. Each is titled, described, and illustrated. Materials necessary for the teacher and students are listed. The final section presents problems for both remedial and more challenging work. The lessons and activities are intended for whole group, small group, or individualized instruction. Worksheets for the students accompany the guide. (Author/SA)

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Comprehensive School Mathematics Program
CEMREL, Inc.

Final Experimental Version
0-00101

CSMP Mathematics for Kindergarten

Teacher's Guide

U.S. DEPARTMENT OF HEALTH,
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Comprehensive School Mathematics Program
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THE GENERATION OF THE CSMP KINDERGARTEN PROGRAM

This Kindergarten program owes its existence to the coming together under the leadership of Burt Kaufman (CSMP Director) of a unique collection of individuals who have been concerned not only about what mathematics children come into contact with, but also about the manner in which that contact is made. This is of even more importance in the crucial early years of a child's life than it is at later points in his or her mathematical education. The program is in large part the outgrowth of a considerable amount of active involvement with children in normal classroom situations, and its present form has been strongly influenced by information gathered from classes participating in an Extended Pilot Test conducted nationwide during 1973-76.

It is in the manner of its presentation that the CSMP Kindergarten program stands out from other curricula, and in this area its origins reaches back further into the past. For your information we now present a rapid survey of the history of some of the main pedagogical ideas and tools which set this program apart from others.

1955: Georges Papy created the Papy Minicomputer, drawing his inspiration in part from some suggestions made by the Belgian cosmologist, Georges Lemaître. The idea was first presented in the book, Minicomputer (Brussels: IVAC, 1968), which Papy wrote in collaboration with Frédérique Papy. Although no English translation of this book has appeared, the Macmillan Company has published a booklet on the subject entitled The

Papy Minicomputer: Teacher's Guide.

1959: Georges Papy introduced colored arrow diagrams[*] into the teaching of mathematics at the secondary level while he was teaching an experimental class of pre-service Kindergarten teachers at the Ecole Normale de Berkendael in Brussels, Belgium. The record of this experiment may be read in French in Premiers Eléments de Mathématique Moderne (Brussels: Ecole Berkendael, 1960), or in German in Die Erste Elemente der Moderne Mathematik: Schriftenreihe zur Mathematik, Hefte 10-11 (Frankfurt & Hamburg: Otto Salle Verlag, 1962-63).

1961: Georges Papy made extensive use of colored arrow diagrams in the experimental curriculum he developed for secondary schools in collaboration with Frédérique Papy. This entire curriculum is available in French under the title Mathématique Moderne, and is published in six volumes by Didier (Brussels & Paris). The first two years of the program (Grades 7 and 8) have been translated into English: Modern Mathematics 1 (London: Collier-Macmillan Ltd., 1968); Modern Mathematics 2 (London: Collier-Macmillan Ltd., 1968).

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[*] For this reason, such colored arrow diagrams are sometimes referred to as "papygrams" in his honor.

1967: Frédérique Papy began an experimental modern teaching of mathematics to elementary school children in which much use was made of the languages of colored arrows and of the Minicomputer. The report of this experiment (which lasted until 1973) may be read in French in the book, L'Enfant et les Graphes (Brussels, Montreal & Paris; Didier, 1968) - co-authored with Georges Papy, in collaboration with Danielle Incolle - and in the series[*] entitled Les Enfants et la Mathématique (Brussels, Montreal & Paris: Didier). Two of these books are available in English: Graphs and the Child (Montreal: Algonquin, 1970) and Mathematics and the Child 1 (Montreal: Algonquin, 1971).

1971: Frédérique Papy began an experiment with four-year old children. Some of the lessons that were developed during the course of this experiment are described in Les Enfants de 4 Ans et le Langage des Graphes (Paris: Classiques Hachette, 1973), which was written by Frédérique and Georges Papy in collaboration with Marie-Thérèse Hoeymans. The results of this experiment have been a constant source of inspiration in the production of the CSMP Kindergarten program.

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[*] The first four books in this series (which are the reports of the first four years of the experiment) have been published by Didier. The reports of the remaining two years exist only in manuscript (information as of 1976).

By making this wealth of experience available to CSMP, Frédérique and Georges Papy have made an invaluable contribution to the production of this program. It must also be acknowledged that the fundamental idea of presenting mathematics to children via "pedagogical situations" is due to the mathematician-psychologist Caleb Gattegno.

Various prototype versions of this program dating back to 1971 were due to the efforts of CSMP staff member Edward Martin and former CSMP staff members Martin Caplan, Lowell Carmony, Pamela Clarke, Jerry Exum, Robert and Henrianne Hammond, Ann Karmos, Sol Pelavin and Don Richert. The preliminary version which has been in use in the Extended Pilot Test since 1973 was primarily the work of former CSMP staff member Jerry Exum. The large quantity of information gleaned thanks to the interest and concern of many teachers in this Extended Pilot Test led to the revision of the program that has resulted in this final version. During the 1975-76 school year, this final version has been tried out by CSMP staff member Christiane Vandeputte in Jackson Park Elementary School, University City, Missouri. In this effort she received the most valued collaboration and support of Kindergarten teacher Margaret Fayne, and the invaluable and motivating response of her students.

This printed copy of the final experimental version of the CSMP Kindergarten program is the result of the labors of the following individuals:

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LIST OF NEEDED MATERIALS

MATERIALS AVAILABLE FROM CSMP:

ITEM	NEEDED IN LESSON
• 0-99 Numeral Chart	K(1),* (6), 16, (20), 47, 56, 97
• Demonstration Numeral Cards**	K6, 12, 71, 99
• Demonstration Dot Cards	K6, (12), 71
• Demonstration Minicomputer Checkers	K6, 19, 21-1, 29, 33, 34, 41, 47, 59-1, 64, 65, (66), (75), 80, 81, 86, 92, 99, (102), 106
• "81 Roses": one copy for teacher, one copy per two students***	K7
• K-A Blocks: one set for teacher and each student	K8, 11, 17, 25, 31, 37, 43, 55, 67, 88
• Worksheets K15-I, II****	(K15)
• Robot Walk Grid	K19, (27), 33, (39), (51), (63), 81, 93
• Demonstration C-Rods*****	K20
• "The Playful Numbers": one copy for teacher, one copy per two students***	K23
• One Way Road Map #1	K34
• Worksheets K36-I, II, III, IV, V	K36-2, 57
• "The Baby Is Born": one copy for teacher, one copy per two students***	K40

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* A lesson number enclosed in parentheses indicates that the item in question is optional for that lesson.

** See Note #1 immediately following this List of Materials.

*** See Note #2 immediately following this List of Materials.

**** See Note #3 immediately following this List of Materials.

***** See Note #4 immediately following this List of Materials.

ITEM	NEEDED IN LESSON
● Track Pieces: two sheets for teacher, eight sheets for the class	K45, 57
● Demonstration Multicolor Numeral Cards*	K53, S1
● Worksheets K59-I, II, III	K59-2
● Worksheets K62-I through XIV	K62, 71
● Worksheets K63-I, II	K63
● One Way Road Map #2	K64
● Catch The Tiger Game Mat	K66, 75
● Two Demonstration Minicomputer Boards (see Note #1 in Lesson K80)	K80, 92, 99, 104, 106
● "What Could We Be?": one copy for teacher and each student	K89
● Worksheet K91	(K91)
● Worksheet K94	(K94)
● Worksheet K100	(K100)
● Worksheet K101-I, II, III, IV, V	K101
● Worksheets K102-I, II, III, IV, V	K102
● Worksheets K105-I, II, III, IV, V	K105
Optional and/or supplementary items:	
● Narration tape for "81 Roses"**	(K7)

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* See Note #1 immediately following this List of Materials.
** See Note #5 immediately following this List of Materials.

ITEM	NEEDED IN LESSON
• Narration tape for "The Baby Is Born"*	(K40)
• Narration tape for "Santa's Shed"*	S1
• Worksheets K-S1-I, II, III, IV, V	S1
• Jigsaw Puzzles with Numbers**	S4
• "Two By Two": two copies	S4

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* See Note #5 immediately following this List of Materials.

** These are packaged with the Demonstration Numeral Cards.

MATERIALS NOT AVAILABLE FROM CSMP:

It is assumed that you have available at all times such common articles as chalk, colored chalk, a ruler or straight edge, a pointer,** pencils, and so on. Such items are not mentioned in the following list.

ITEM	NEEDED IN LESSON
• Centimeter Rods**: one set per one, two or three students	K2, 5, 14, 20, 38, 78, 87
• Recordings of counting songs	(K3)
• A magnetic board (see note in Lesson K6)	K6, 21-1, 29, 41, 47, 59-1, 65, 80, 86, 92, (97), 99
• A number of identical large objects (e.g., bricks, short planks)	K9 (Six), 35 (Eight), 102 (Ten)
• A towel	K17, 31
• A small doll (robot, policeman, fireman, etc.)	K19, 33, 81
• Masking tape	K20, 69, (72), (78), (87)
• Colored pens, pencils or crayons for the students	K21-2, (29), 36-2, 40, (49), (51), 53, 57, 59-2, 60, 63, 69, (71), 91, 100
• Paper for the teacher and/or the students	K21-2, (29), (40), 48, (49), 53, 56, 77, 91, 95, 100
• A full-length mirror	K24, 78, 87
• A very large sheet of paper (e.g., cut from a roll of newsprint or wallpaper)	K26, 105, 108
• Small colored paper rectangles: several per student	K26, (64), 108

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* See Note #6 immediately following this List of Materials.
** See Note #4 immediately following this List of Materials.

ITEM	NEEDED IN LESSON
• Glue	K26, 108
• Colored crayons, felt tip pens or finger paint for the students	K26, 108
• A square grid (see note in Lesson K27)	K27, 39, 51, 63
• Various solids (see note in Lesson K30)	K30, 42
• Scotch tape	K34, 64, (69), 93, (97), 105
• A very large sheet of translucent paper (e. g., low grade wrapping paper)	K36-1
• Water and paper towels	K36-1, 48
• An easily reversible glove (not a mitten) for each child	K36-1
• Finger paint of two colors for the students	K36-1, 48
• Newspaper to cover the floor	K36-1, 48
• An apron or smock for teacher and each student	K36-1, 48
• A box	K37
• Some cubes	K42
• Sandbox	(K42)
• Overhead projector	K(42), (58), (103)
• Lengths of string or yarn of different colors (see individual lessons for specifications)	K43, 55, 72, 84, 96
• Stamps and inkpads; or templates and watercolor or finger paint (see note in Lesson K48)	K48

ITEM	NEEDED IN LESSON
• A Number Line	K50, 68
• Grid paper for the students	(K51)
• Four distinctive paper hats	K52
• A stapler	K53
• Several non-hollow solids which can be cut (see note in Lesson K54)	K54
• Large breadknife or electric knife	K54
• Visual aid pen for teacher	K(58), (103)
• A coat or jacket whose inside and outside are different colors (such as a reversible parka)	K60
• Small cylindrical bands for the students (see note in Lesson K60)	K60
• Small Moebius bands for the students (see note in Lesson K60)	K60
• A large cylindrical band (see note in Lesson K60)	K60, 69
• A large Moebius band (see note in Lesson K60)	K60, 69
• Colored pens or magic markers for teacher	K60, 69, (105)
• Some stick-on stars	(K63)
• A small toy tiger (or other wild animal)	K66, 75
• Two dice	K66, 75
• Two strips of paper for teacher and each student	K69

ITEM	NEEDED IN LESSON
• One or two rolls of colored ribbon	(K69)
• A meterstick	K72, 84
• Scissors for teacher and students	K72, 105
• Pieces of paper with numerals written on them (see individual lessons for specifications)	K74-1, 104
• A ball	(K74-2)
• A paper cup containing 15 checkers for each student	K77, 95
• Some fairly large objects (e.g., a large doll and a large teddy bear)	K78, 87
• A few pocket mirrors	K78, 87
• Numeral cards from 11 through 49 (with the exception of 20, 30, 40)	K83, 97
• A box full of checkers, or buttons, or bottle caps for each student	K83
• A musical instrument	(K86)
• Several needles, corks and cut-out spirals	(K91)
• A special "robot" doll (see Lesson K93 for details)	K93
• Some means of producing background music (tape recorder, record player, musical instrument, etc.)	(K93)
• 27 small paper rectangles	(K97)
• 27 large magnetic checkers	(K97)

ITEM	NEEDED IN LESSON
A 25cm diameter ball (see note in Lesson K101)	K101
A half-pint milk or cream carton (see note in Lesson K101)	K101
A coffee mug (see note in Lesson K101)	K101
A 10-ounce returnable Pepsi-Cola bottle (see note in Lesson K101)	K101
A paper bag	K102

NOTES:

1. The Demonstration Numeral Cards should be permanently mounted in your classroom as a Numeral Row (see Section Two: Numbers Are Everywhere ... Or Should Be). This means that you will have to take them down for those lessons when they are specifically called for, and put them back up when such a lesson is over.

   The Demonstration Multicolor Numeral Cards (which are packaged with the Demonstration Numeral Cards) will be useful to you in many ways (some of which are described in Section Four: Supplementary Activities, particularly in S1: Numeral-writing), but their general usefulness might be enhanced if they too were permanently mounted in the classroom. One way of doing this would be to position each multicolor card above the corresponding black and white card in the Numeral Row.

2. Even though we require only one storybook for every two students, your students would enjoy it greatly if they were able to have a copy of the storybook to keep. Additional copies can be obtained from CEMREL-CSMP, by using the individual item section of the order form.

3. The worksheets are packaged in pads, separately from this teacher's guide. The level of difficulty is generally indicated on the worksheet. "*" represents an easy worksheet, "**" represents an average level worksheet, and "***" represents a difficult level worksheet. Unless otherwise stated in a lesson, all students should begin with the "*" level

worksheet and proceed as far as possible. No one should ever be required to attempt all the worksheets provided for a given lesson. Each child should progress as far as his or her abilities allow.

4. In this teacher's guide, wherever we have dealt with centimeter rods we have always referred to them by the colors of the rods made by and available in Classroom Kits from

The Cuisenaire Company of America
12 Church Street
New Rochelle, New York 10805.

There are many other distributors of centimeter rods, among them

Numerods: Mead Educational Services,
245 North Highland Avenue, N. E.
Atlanta, Georgia 30307

Model Publishing and School Supply Company
1604 Hodiamont Avenue
St. Louis, Missouri 63112

Plastic Rods: Houghton-Mifflin Company
1900 South Batavia Avenue
Geneva, Illinois 60134

Color Factor Rods: Leicester Learning Systems,
Box 335
New Gloucester, Massachusetts 04260.

Hence if you did not obtain your rods from the Cuisenaire Company of

America you will have to make suitable adjustments in the references to colors during centimeter rods lessons. In addition you will be unable to use the Demonstration C-rods provided by CSMP since they are colored to match the Cuisenaire © Rods. Therefore, for Lesson K20 you should either make your own set of demonstration rods, or turn the Demonstration C-rods over and color the backs to match the colors of the rods your children are using.

5. The narration tapes for the storybooks can be obtained by sending a blank 30-minute cassette tape to CEMREL-CSMP (two stories can be recorded on such a tape). The recorded tape will be returned to you free of charge. Please be sure to mention the title of the stories to be recorded in your request for the tape, and include a stamped, self-addressed envelope.

6. You will find it extremely useful to have a pointer permanently available in your classroom. With it the children can point to parts of drawings on the board which are out of reach, trace along where they want an arrow drawn before you draw it and without erasing any part of the drawing involved, and be able to perform these tasks while standing to the side of whatever is drawn on the board, thus not blocking the view of the rest of the class. There are a number of commercially available pointers, but it would probably be less expensive if you made your own out of a meter long piece of light dowel rod. As a last resort you could use a meterstick (or similar object), but this would be much more unwieldy.

Section One:

OPEN LETTER TO THE TEACHER

OPEN LETTER TO THE TEACHER

You are about to teach the CSMP Kindergarten program, perhaps for the first time. We wish you good luck in your teaching and hope that both you and your students will enjoy the activities suggested in this teacher's guide. It is the purpose of this letter to help you get maximum use out of this book. The guide consists of four sections.

Section One: Open Letter to the Teacher

This section includes answers to the questions which are most frequently asked about the program.

Section Two: Numbers Are Everywhere ... Or Should Be

This section is primarily a collection of ideas about developing a good numerical environment. It also includes descriptions of several quick number activities (each lasting from five to ten minutes) which are intended for DAILY use.

Section Three: Day-By-Day Guide

This section of the guide is arranged on a day-by-day basis, the number of the lesson indicating when it should be taught. Thus Lesson K1 should be the first mathematics lesson of the year. Lessons K74-1 and K74-2 should together make up the 74th mathematics lesson of the year. In this section we have provided enough materials for three mathematics lessons per week, each lesson lasting about 20-30 minutes, but you should feel free to teach mathematics more or less often. Please note that, when two activities are scheduled for the same day, it is an indication that we do not think either of them should last as long as 20 minutes (unless otherwise specified).

Section Four: Supplementary Activities

This section includes a collection of ideas about dealing with some of the specific problems that you will probably encounter, and about handling some of the teaching situations in which you might find yourself. In particular, this section deals with:

- Numeral-writing
- Arrows
- Exercises in listening
- Small group activities

Under this last heading, we have included both activities whose intent is "remedial," and those which involve more "challenging" questions.

A preliminary version of this program has been taught by a large number of teachers all across the United States since the Fall of 1973. The reactions of most of these teachers were very enthusiastic.*

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*The teachers' reactions that follow are taken from CSMP Evaluation Report Series, "Evaluation Report 1-C-5: Interviews with CSMP Kindergarten Teachers" (St. Louis: CEMREL, Inc., 1974).

> I was very pleased with the program. The children have shown remarkable progress in math that I have not seen before in kindergarten. CSMP has given me a lot of new views toward math which I would use even if it does not become a permanent program. I have enjoyed teaching math more this year than ever before. I have enjoyed what I have learned.
>
> Oh, I just love it. I really like it. I think it does a good job. It draws out the children.
>
> I really like it. The children enjoyed it. The children learned more than from a regular program. CSMP is more inclusive, has more in it.
>
> At first I was mixed up. As I realized it was a spiral learning I got more used to it and enjoyed it better.

The teachers of the preliminary version have helped us considerably by sending us their comments and their questions. These have been of invaluable assistance as we have made the improvements that have resulted in this final version of the program. We would like to take this opportunity of thanking all those teachers who have helped us in this way.

The remainder of this letter attempts to answer the questions that are asked most frequently about the program. Perhaps the questions that concern you are answered on the following pages.

Q. WHAT IS THE SPIRAL APPROACH? DOES IT WORK?

A. This curriculum has been built following a spiral approach. Here is how it works: a certain idea is introduced, then another idea, and another. Then the spiral comes back around to a lesson on the first topic, which is slightly expanded and further developed. Next there follows a similar expansion of the second topic, and so on. Each time a particular area comes up, it is treated at a slightly higher level of sophistication. The idea behind this philosophy is that only part of the learning of a given topic actually takes place during the lessons which deal specifically with that topic. In between the time a subject is introduced and the time when it is discussed again, things are "percolating" — the child is digesting the material, sometimes consciously, sometimes unconsciously. Thus adherents to this philosophy believe that, at the end of a child's education, the total amount of mathematics that has been experienced, assimilated, applied and reacted to will be far greater than it would have been had he or she been exposed to a solid block of Topic A, followed by a solid block of Topic B, and so on.

Sticking with this spiral idea requires a tremendous act of faith on your part, particularly if you have been used to teaching a given topic until you are satisfied that all (or at least most) of the class has understood it. Belief in the spiral approach implies that a lesson may be stopped before many children appear to have "caught on," or, in those lessons involving worksheets, before everyone has completed all the worksheets. It involves knowing that the topic will come up again and again and that understanding will come at widely different rates. It entails a belief that an idea planted now may not sprout until much later, and that it is ultimately more beneficial not to force its development. All our experience to date has indicated that this approach really works!

Q. HOW CAN I ASSESS MY STUDENTS' PROGRESS?

A. We believe that it is neither desirable nor even reasonable to attempt to evaluate student mastery of skills at such an early age. Your knowledge of your students and your observations of what takes place during the lessons probably constitute the best evaluation possible.

Some school systems insist on testing children at the end of Kindergarten. In such a case, any standard readiness test can be used. However, our evaluation staff has constructed a test on CSMP Kindergarten content. This test has been administered both to some CSMP Kindergarten classes and to some comparison classes during the course of the pilot trial of this program. A copy of this test, together with the data gathered as a result of its administration, may be found in CSMP Evaluation Report Series, "Evaluation Report 1-B-4: End of Year Test Data - CSMP Kindergarten Content" (St. Louis: CEMREL, Inc., 1974).*

Q. WHY DON'T YOU LIST THE GOALS FOR EACH LESSON?

A. The principal goal of this program is to provide each child with a great variety of experiences in different fields. Such a goal is difficult to break down into small pieces.

Roughly speaking, however, the lessons can be divided into three categories:

- Some lessons deal specifically with number concepts (counting, numeral-writing, number recognition, conservation of number, "more than," "less than," preparing the ground for the introduction of addition and subtraction).

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* A copy of this report may be obtained from CEMREL-CSMP, 3120 59th Street, St. Louis, Missouri 63139.

- Some lessons have the intention of familiarizing the child with languages which are used throughout the CSMP curriculum (for example, the languages of strings and arrows).

- In other lessons it is our aim to provide the student with various geometrical experiences, some of them familiar (such as the exploration of various solids, or mirror geometry), others less usual (such as taxi-geometry or some of the activities in the "One Side - Two Sides" lessons).

Q. HOW MANY MATH LESSONS SHOULD I TEACH EACH WEEK?

A. The day-by-day guide provides enough material for three lessons, each of about 20-30 minutes duration, per week. We think that is ample for a Kindergarten student.

You might not want to teach mathematics that frequently. That's fine. Just follow the day-by-day guide as far as you can.

You might want to teach mathematics more often. In that case, we still suggest that you teach no more than three lessons per week out of the day-by-day guide. For the other two days, you could use your own initiative (either you could create your own lesson, or try out some ideas from Section Four of this guide, or repeat a Number Readiness activity, and so on).

But, no matter if you schedule only one mathematics lesson a week or if you teach mathematics every day, you should still devote about five or ten minutes DAILY to the short activities described in Section Two of this guide.

Q. IF I TEACH MATH ONLY ONCE A WEEK I WILL NEVER GET THROUGH THE WHOLE PROGRAM. WHICH TOPICS ARE PREREQUISITE FOR THE CSMP FIRST GRADE PROGRAM?

A. Strictly speaking no topic is prerequisite for the First Grade Program. But the more experiences a child has had, the better off he or she is likely to be. We all know that a child

- who is unable to attend to and carry out a simple instruction
- who has trouble situating himself in time or space (left, right; up, down; before, after)
- who does not know the names of the basic colors
- who cannot count a small number of objects
- who is unable to recite the numerals from "one" to "ten" in order
- who cannot recognize a single numeral

by the time he or she enters First Grade, will most likely have a difficult time there, not so much because of the program itself, but because of the gap that will exist between that child's basic knowledge and that of most of his or her peers.

Indeed, if one of your students has failed to acquire this basic knowledge by the time of his or her completion of Kindergarten, it might be worthwhile approaching the appropriate school authorities with a view to discovering if there is some specific (physical or mental) problem provoking such a failure. It might also be worthwhile to try to persuade the child's parents that it might be for the best, both in terms of the child's happiness and of his or her welfare, if the Kindergarten year were repeated.

Q. HOW LONG SHOULD A MATH LESSON LAST?

A. This will vary from one class to another. In our experimental classes the lessons lasted about 20-30 minutes. When an activity is not likely to last that long we have planned another activity for the same day. The activities which are intended for a single day are either described as parts of a single lesson and listed under one title, for instance:

K3 Number Readiness #1

or else they are described separately and listed under several titles, each bearing the same number, for instance:

K18-1 Orchestra

K18-2 Everyone Listen, Everyone Acts

Never drag a lesson on when your students have lost interest in it!

Q. I GET STUDENTS WHO DON'T EVEN KNOW THEIR NAME. DO YOU REALLY EXPECT ME TO TEACH MATHEMATICS FOR 20 MINUTES EVERY DAY? THEY CAN'T SIT STILL FOR FIVE MINUTES!

A. In the last analysis, you are the only one who can really decide how long a mathematics lesson should be. In this specific case, it would probably be a good idea to devote a couple of months to "socializing activities." Be sure, however, to include five or ten minutes of short mathematics activities each day (see p. 20 for some ideas) in addition to devoting some time to Exercises in Listening (see Section Four). Don't start on the day-by-day guide until later in the year.

Q. SOMETIMES WHEN I READ ONE OF THE LESSONS I JUST FEEL IT'S NOT GOING TO WORK WITH MY CHILDREN, OR DOESN'T AT ALL FIT MY STYLE OF TEACHING. DO I HAVE TO TEACH EVERY SINGLE LESSON?

A. No! You know your students; you have to teach the lesson; so you should be the one to make the final decision. However, teaching is a little bit like cooking: sometimes it pays off to be a little adventurous and give a lesson a try even if you have "mixed feelings" about it.

Q. I'VE JUST SPENT MY WHOLE SUMMER PREPARING SOME REALLY EXCITING MATH ACTIVITIES. CAN I USE THEM IN ADDITION TO THE CSMP MATERIALS?

A. Of course you can! Most Kindergarten teachers are very creative people and as a result there are a lot of "exciting activities" around. It would be sad to let them go to waste. Be careful, though, that you don't "overfeed" your students.

Q. AS SOON AS I SAW THE FIRST PAGE OF THE FIRST LESSON I KNEW THIS CURRICULUM WAS NOT FOR MY STUDENTS. 16 DOTS RIGHT AWAY! THEY CAN'T COUNT THAT FAR!

A. You mean, not a single one of them can? Even with a little help? The counting of those 16 dots is there merely to whet the appetite of those students who already know a good many number facts. (Of course, it is good practice for everybody!). If you look at the remainder of the first lesson, though, you will notice that the numbers we deal with are all smaller than five.

And it is so much more fun to look at an arrow picture that includes quite a number of arrows than to focus just on one or two dots!

Q. WHAT ABOUT THE SLOWER STUDENTS?

A. We have tried to include in every lesson something these children can do. But we also feel it is important that every lesson should contain something more challenging for the other students. This means that you should not exclude any students from a full group lesson. But, by the same token, you should not expect every child to understand everything at every moment of each lesson!

One very efficient way of helping your slower students is to work with them in smaller groups. You will find some suggestions for Small Group Activities in Section Four.* You might also find some of the Numeral-Writing Activities which are described in Section Four to be appropriate for these children. Finally, Section Four also includes some Exercises in Listening. It's a fair bet that your slowest students will not be the only ones who could benefit from such activities!

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* These small group activities are intended to be additions to the lessons from the day-by-day guide, not replacements for them!

Q. IN LOOKING THROUGH THE DAY-BY-DAY GUIDE, I WAS SHOCKED TO FIND THAT THERE IS A FULL-GROUP INTRODUCTION OF THE PAPY MINICOMPUTER. MY SLOWER STUDENTS WILL BE LOST FROM THE VERY FIRST MINUTE! WOULDN'T IT BE BETTER TO LEAVE THEM OUT OF THESE LESSONS?

A. The few Minicomputer lessons which are scheduled in the day-by-day guide are not in the least intended to be taught for mastery. The idea is merely for the children to become acquainted (even only slightly) with a tool to which they will again be exposed in Grade One.

Don't exclude any slower students from such a "getting acquainted" experience. Whatever such a student learns from an experience like this might turn out to be helpful later on.

Q. SOME OF MY BETTER STUDENTS COULD DO SO MUCH MORE ON THE MINICOMPUTER THAN THE LESSON PLANS PROVIDE. ANY SUGGESTIONS?

A. The Small Group Activities in Section Four include some suggestions on this topic.

Q. WHAT SHOULD I DO WHEN A LESSON IS OBVIOUSLY AN UTTER FAILURE?

A. Stop it immediately! It is senseless to drag on through a lesson when no one is listening. You can either forget about the lesson completely, or else you could try it again a couple of weeks later, making any modifications that you think would help.

Q. SOMETIMES TWO LESSONS HAVE THE SAME NUMBER (FOR EXAMPLE, K18-1 AND K18-2). WHAT DOES THAT MEAN?

A. The number of the lesson indicates the day on which we suggest it should be taught. Lesson K1 should be taught the first time you have scheduled a mathematics lesson, Lesson K2 the second time, and so on. It is our suggestion that Lessons K18-1 and K18-2 should both be taught on the same day (unless you decide otherwise[**]). It means that we feel Lesson K18-1 is not enough for a normal mathematics period (20 to 30 minutes).

Q. WHEN TWO LESSONS OR TWO ACTIVITIES ARE SCHEDULED FOR THE SAME DAY, DO I HAVE TO TEACH THEM BOTH?

A. It's up to you. You can, but you don't have to. In particular, number readiness lessons always suggest two activities because most students we have worked with seem to tire of these activities rather quickly. So we felt it was necessary to switch after ten minutes or so. Sometimes, however, one activity was so successful that we just stayed with it for a full 20 minutes. Then there were the times when one of the activities we had planned did not appeal to a particular group of students at all. On such occasions we were grateful to have planned the second one.

[**] The answer to the next question has something to say about this.

Q. CSMP DOES NOT TEACH HOW TO TELL TIME. WHY?

A. There are many excellent materials available to help you with this. Why duplicate them? Furthermore, we feel that teaching the telling of time is more naturally a part of a language program than of a mathematics program.

This same answer applies to

- teaching ordinal numerals (first, second, third, and so on)
- teaching the measurement of weight and capacity.

However, we have felt free to make reference to these concepts, particularly ordinal numbers, in this guide. Notice also that we have included some activities that deal with linear measure.

Q. THE MEASUREMENT ACTIVITIES ONLY USE THE METRIC SYSTEM. WHAT ABOUT YARDS, CUPS AND OUNCES?

A. In the near future the United States will have completely adopted the metric system. Your students will have to live in this new world. Give them a good start by using

a meter stick for measuring lengths

a metric scale (gram - kilogram) for weighing things

metric containers (liter - half liter) for measuring quantities of liquids

if ever you have cause to engage in such activities. In any case, don't panic! Once you have the stick, the scale, and the containers it really is easy. For the time being, forget about yards, cups, and ounces. It would be rather confusing to your students if they had to deal with both systems at this early stage.

Q. I PREFER TEACHING SMALL GROUPS, BUT MOST OF YOUR LESSONS SEEM TO BE AIMED AT THE WHOLE GROUP. WHAT DO YOU SUGGEST?

A. What you say is true, but you can always teach each lesson twice, once to each half of your class. In addition, in Section Four there is a collection of supplementary activities which are especially designed for use with small groups.

Q. I LIKE MY STUDENTS TO HAVE SOME MATH WORK TO DO INDIVIDUALLY. IS THERE ANYTHING OF THIS NATURE IN THE CSMP KINDERGARTEN CURRICULUM?

A. Some of the lessons include worksheets that can be used on an individual basis. In addition, cassette tapes of the storybooks are available so that children can enjoy them individually. The provision of any further individual activities is left up to you.

Q. ARE THERE ANY SUPPLEMENTARY MATERIALS FOR VERY BRIGHT STUDENTS?

A. Some of the Small Group Activities described in Section Four are intended for use with your more capable students.

Q. ARE THERE ANY SUPPLEMENTARY MATERIALS FOR SLOW LEARNERS?

A. You will find some among the Small Group and the Numeral-Writing

Activities in Section Four.

Q. THERE ARE NO EXERCISES AIMED SPECIFICALLY AT THE ADDITION AND SUBTRACTION FACTS. WHY SHOULDN'T I GIVE THE STUDENTS SOME WORKSHEETS TO DO?

A. Addition and subtraction are present throughout this entire curriculum. However, we have avoided presenting them in a formal way. Instead, our intention is for our students to understand these concepts so well that, when they arrive in Grade One, the formalism will flow easily.

Q. THE DAY-BY-DAY GUIDE DOESN'T INCLUDE MANY EXERCISES ON WRITING NUMERALS AND MY STUDENTS NEED PRACTICE IN THAT AREA. WHAT SHOULD I DO?

A. In Section Four there is a collection of ideas about writing numerals.

Q. SOME OF MY STUDENTS DON'T SEEM TO BE ABLE TO FOLLOW ARROWS. CAN I GIVE SOME ADDITIONAL HELP?

A. Section Four also contains a collection of ideas about this subject.

Q. WHY IS A "DIALOGUE" STYLE USED AS THE FORMAT FOR THE LESSON PLANS? ARE TEACHERS EXPECTED TO FOLLOW THE DIALOGUE EXACTLY?

A. Most lessons are written in considerable detail. Step by step descriptions are frequently given, together with suggestions for the exact words that a teacher might use (in the form of an imaginary dialogue between teacher and students). These details are there only for teachers who want to use them. You should never feel obligated to follow the lesson plan exactly as it is written but you will find it helpful to have read the lesson plan carefully beforehand.

In closing, we would like to wish you all the best in your teaching.

Have fun!

The CSMP Staff

St. Louis, Missouri
August 1976

Section Two:

NUMBERS ARE EVERYWHERE ...or should be

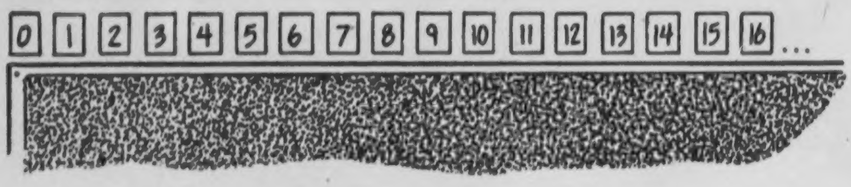
NUMBERS ARE EVERYWHERE ... OR SHOULD BE!

Adults usually find it very difficult to learn a new language. How is it, then, that young children learn their mother tongue so easily? The early age at which that learning occurs is surely the most important factor. But, in addition to that, the child learns the language because he lives in a suitable linguistic environment. The way this learning takes place is one of the most beautiful examples both of the spiral approach and of the pedagogy of situations.

These factors—early-age experiences and a suitable environment—play an important role in the learning of numbers too.

What can a teacher do to create a good numerical environment? The following suggestions deal with things which could make all the difference between a numerically rich classroom situation and a numerically impoverished one. You will, of course, think of additional ideas in the same spirit as you become more familiar with the particular needs of your children.

- Display a "Numeral Row" in your classroom. For this purpose you can use the Demonstration Numeral Cards; hang (or otherwise display) them in order from left to right on your wall or above the chalkboard. Do this in such a way that they are easily removable.


0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 ...

A child who cannot immediately locate a numeral in this row should be allowed to do so by counting from the left, starting from 0 or 1.

A Numeral Row such as this is referred to in many of the lessons in the CSMP Kindergarten curriculum.

- Take advantage of every opportunity to help students become acquainted with numbers. For instance: birthdays, phone numbers, addresses, a calendar. When you "meet" a number give the students a chance to express it in different ways. For instance, it is Janet's birthday; she is six. You could ask a student to point to "6" in the Numeral Row, to tap six times on a box or on the desk. Everyone could trace a "6" on his or her desk or in the air, show six fingers, and so on.

- For small numbers (1 through 6 or 7) of objects, encourage your students to answer the question, "How many?" without counting. Make sure this is clearly understood: some children seem to think teachers like to hear them count! Nevertheless, a child who really cannot find the answer without counting should be allowed to count at any time. He should also be encouraged to count in order to check answers given by his peers.

- Many daily activities involve numbers. For instance:

  Let's suppose your room has exactly the same number of chairs as students. As you enter the room in the morning, look at your classroom and announce: Without counting how many of you are here today, I know exactly how many children are absent. Do you know how?

As an alternative to the preceding activity you could ask someone to count how many children are present. (Let's suppose 21 children are there.)

T: When everyone is here, there are 24 students. Today, there are only 21. How many are missing?

How many girls are here today? How many boys? Are there more girls or more boys? How many more?

Read and write the date every morning. Today is the 21st. Yesterday it was the ...? Tomorrow it will be the ...? In three days' time it will be the ...?

Take advantage of opportunities that arise during distributions and related activities. For instance, at lunchtime: The children are sitting at tables for four. Ask a child to distribute the milk. Give him three (or five) milk containers and ask, "Is that enough for your table?"

A good way to become familiar with money is to have a little shop inside the classroom.

● There are a great many very short number activities which can be used as five-minute time-fillers. Some are described briefly below, but you probably already know many others and have your own favorites. Feel free to use them in addition to the ones we suggest.

The only materials you will need for any of the short number activities suggested below are the Demonstration Dot Cards and the Demonstration Numeral Cards.

Don't Make a Sound.

First, you draw a dot picture (or write a numeral) on the chalkboard. Then you hold up the Demonstration Numeral Cards (or the Demonstration Dot Cards) one by one. The students are not to make a sound until the matching card is shown. When the matching card is shown they should call out, "That's it!"

Number Contest.

A volunteer chooses a numeral card and shows it to the class. He or she has to read it, to tap that many times on the desk, to find it on the number line. If these tasks are performed correctly, the volunteer may choose the next player. If a mistake is made, the student who spots the mistake is next. (If no student notices the mistake, the teacher should designate the next player after having pointed out the mistake.)

Rhythm.

Tap a sequence of sounds on a student's desk. Ask a student to reproduce the sequence exactly (by tapping on his or her desk), while the class listens to check the answer.

Counting Songs.

There are many counting songs. Among the most well known are "Ten

Little Indians" and "The Twelve Days of Christmas." From time to time, you could suggest that the numbers be changed for the sake of variety ... and additional counting practice. For example, try singing "Ten Little Indians" starting at the number two and using just the even numbers: "Two little, four little, six little indians." Don't forget to include in your repertoire some songs which involve counting backward.

Finger Games.

Ask the students to show six fingers; show six fingers in another way; show six fingers in yet another way.

Ask the students to show four fingers on one hand, and three fingers on the other. How many fingers are shown altogether?

Choose two students. Together they are to show nine fingers. Let them decide how to solve the problem. Afterwards, ask if it is necessary to have two students in order to show nine fingers. Proceed in a similar fashion for 12 fingers.

Last Year, Next Year.

T: Mary, how old are you?

Mary: Five.

Ask everyone to hold up five fingers.

T: How old will you be next year?

Mary: Six.

Ask everyone to hold up one more finger.

T: My friend Julita is three. Next year she will be . . . ?

My friend Sam is seven. Next year he will be . . . ?

My friend Denise is six. Next year she will be . . . ?

As the children become more familiar with this activity, their need to use their fingers should gradually diminish.

Variations.

1) **T:** My friend Lou is four. Last year he was . . . ?

2) **T:** My friend Sue is seven. Last year she was . . . ?

And next year she will be . . . ?

Think Fast.

Seat the children in a circle. Explain to them that you are going to designate someone and call out a number. This student has to tell you which number is one more than the one you mentioned.

Variations.

1) Throw a ball to the student as you call out the numbers. The ball is to be thrown back as he or she answers.

2) Change the rule: You could ask for a number that is "smaller," "larger," "one less," "two more" than the one you mentioned.

Section Three:

DAY-BY-DAY GUIDE

TITLE: Fish and Fishermen

MATERIALS:

Teacher - Colored chalk*; a pointer*

Students - None

IMPORTANT NOTE:

Make big drawings. Spread the dots out across the entire board so that the arrows that you draw will be long. As you are drawing the dots, be thinking about the way you want the arrows to be arranged. This will help you with your layout. Make sure that all strings and arrows are clearly visible (if necessary, draw them using the side of a small piece of chalk).

DESCRIPTION OF LESSON:

Start the lesson by having a brief discussion about fish and fishermen. For example, you might ask:

T: Have you ever been fishing? Tell me about it.

Let some of the children recount their experiences.

T: I am going to draw some dots: some are for fish, some are for children. Count them as I draw.

Draw 14 dots on the board as follows:

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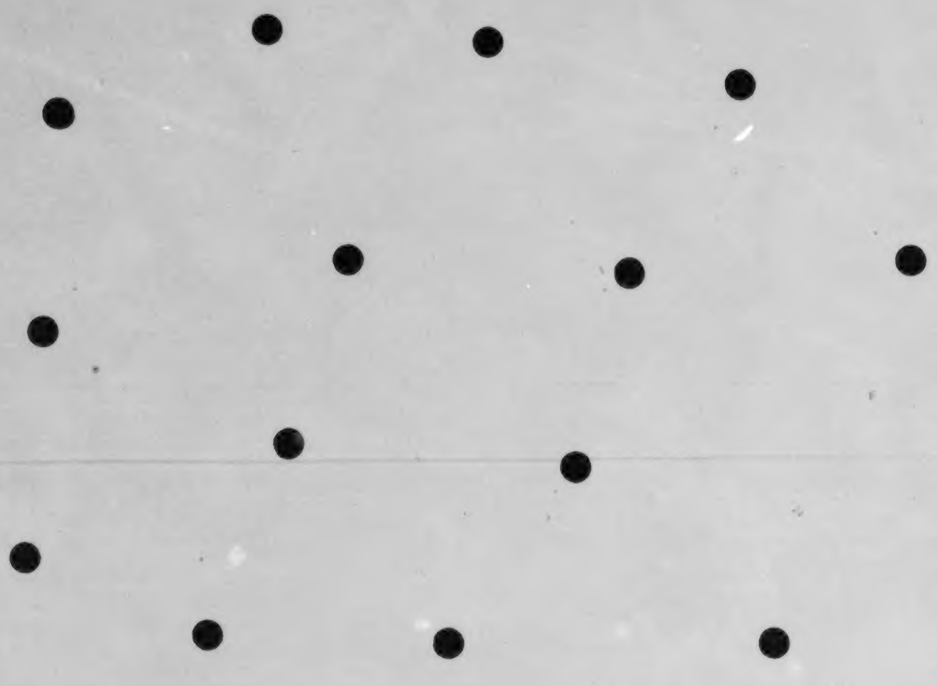
* Whenever you see an asterisk in this teacher's guide next to the mention of an item of equipment, it means that item is not available from CSMP.



T: How many dots are there?

S: 14.

Ask a volunteer to check this answer (by counting the dots as he or she points to each one in turn), and then to point to "14"[*] in the Numeral Row.

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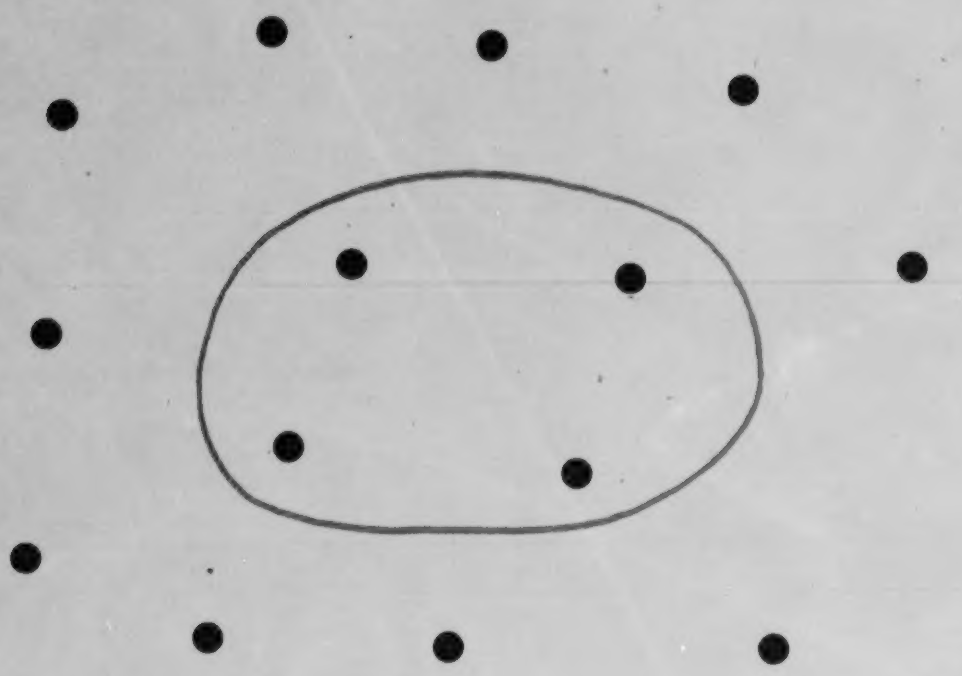
[*] In many of the lessons, it is suggested that a student be asked to point to a numeral. Hence you will need to have a display of numerals in your room. For this purpose you can use a "Numeral Row" (see Section Two, "Numbers Are Everywhere ... Or Should Be," for details about this), the 0-99 Numeral Chart, a number line, a calendar, or some other display of numerals. This kind of symbol recognition is important and opportunities for practice should be provided often. Don't be afraid to display numerals other than those with which the children are already familiar.

T: What do the dots stand for?

S: Fish or children.

Draw this yellow string around four of the dots.



T: The dots inside the yellow string are for the children.

How many children are there?

S: Four.

Ask someone to point to "4" in the Numeral Row. Ask everyone to show four fingers.

T: How many fish are there?

S: Ten.

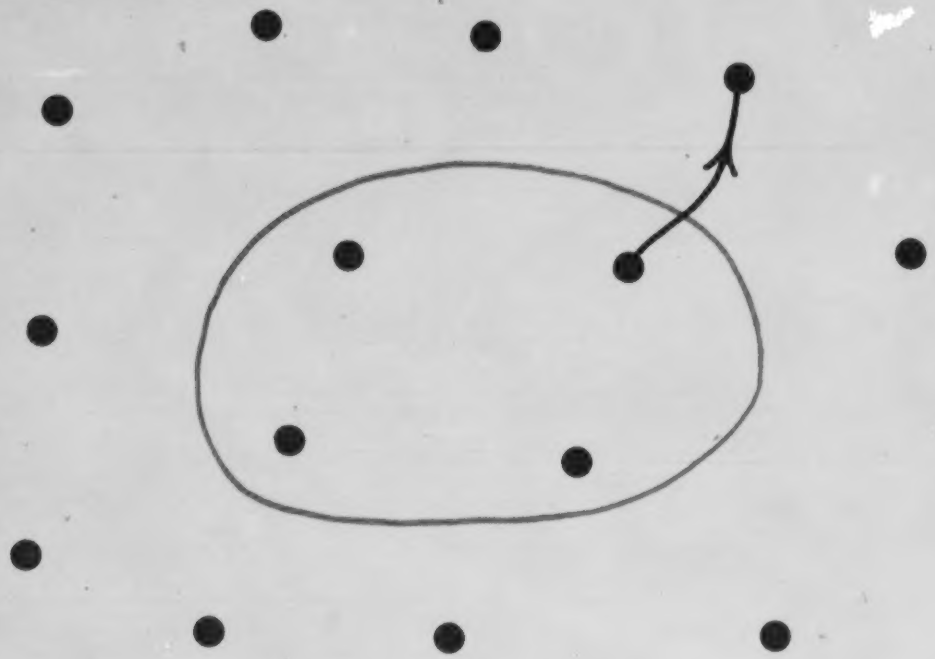
K1

Ask someone to point to "10." Ask everyone to show ten fingers.

T: What do you think the children are trying to do?

It is to be expected that someone will suggest the children are trying to catch the fish.

Draw this red arrow:



and, as you draw it, say:

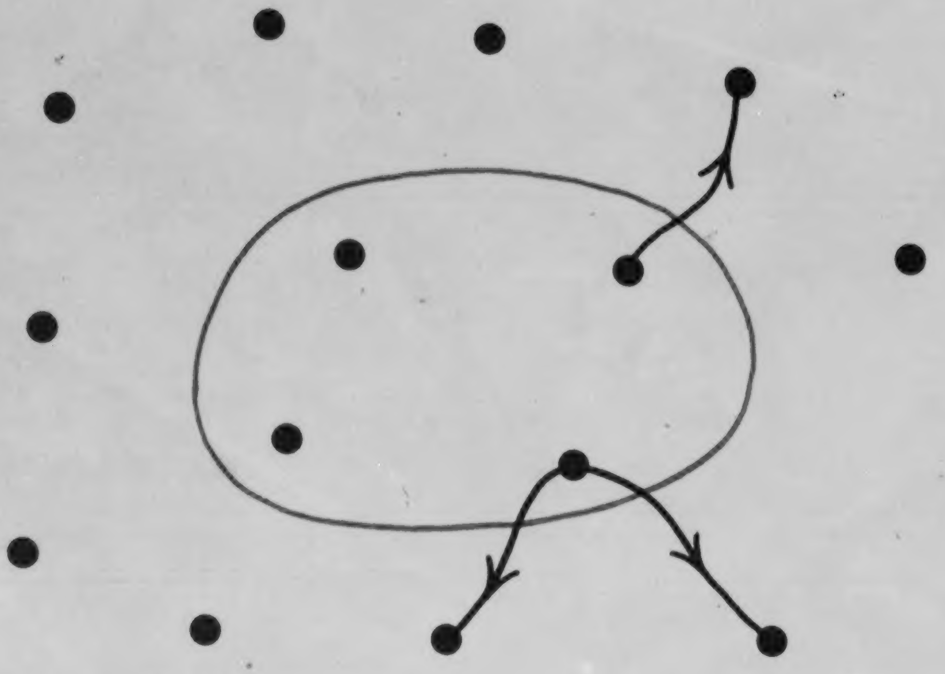
T: This child catches this fish.

John, would you point to another child? That child catches two fish.

Choose which two he catches.

With the rest of the class watching, John should trace two arrows (using a pointer or a ruler).

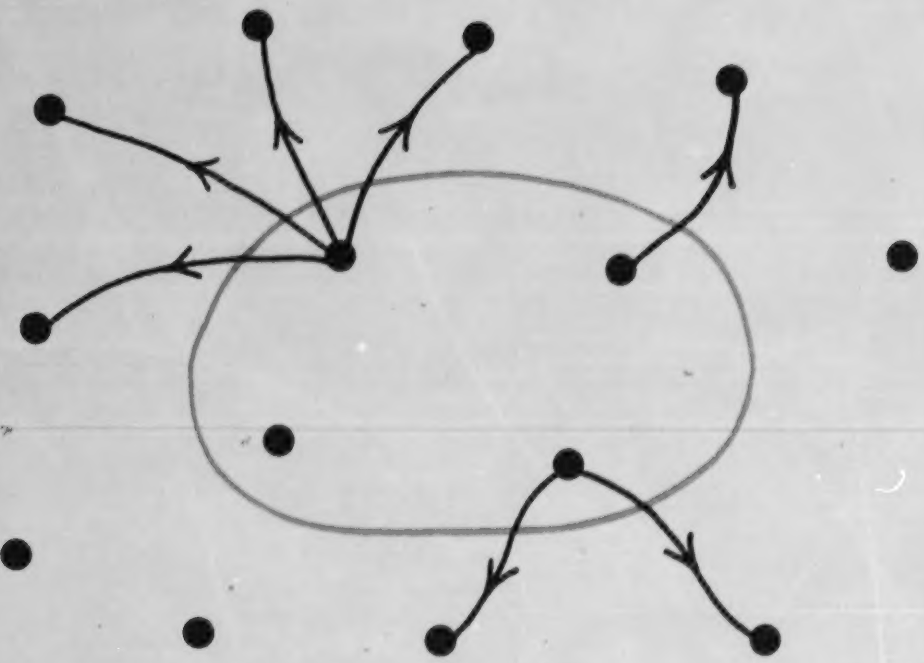
Draw the arrows yourself. For example:



T: Mary, would you point to another child?

That child catches four fish. Show me which four.

Let Mary trace the arrows, but once again you should be the one who actually draws them. For example:



T: That's the end of our story. Look very carefully at the picture we have drawn.

Was every fish caught by somebody? (No)

Ask your students to hold up enough fingers to show how many fish escaped. (Three)

T: Were all the children lucky enough to catch a fish?

(No, one caught no fish at all.)

EARLY WARNING:

Lesson K2 calls for one set of centimeter rods per one, two or three children. For information about where you can obtain these, see the List of Materials.

TITLE: Centimeter Rods #1 (Free Play)

MATERIALS:

Teacher - None

Students - One set of centimeter rods* per one, two or three children.

IMPORTANT NOTE:

Two lessons (K2 and K5) are scheduled for free play with the centimeter rods. Feel free to devote additional time to this topic if you think your class would find it useful.

DESCRIPTION OF LESSON:

For the purposes of these free play activities it would be beneficial if each child could have a set of rods. However, if this is not possible, you will obtain good results by letting the children work with one set of rods between two or three children. Start the lesson by distributing the sets of rods and making sure everyone has a flat surface (desk, table or floor) on which to work. Explain to the students that they should simply play with the rods and that you would like them to create some beautiful designs.

As they start working you may need to make the point that, although each child (or group of children) is free to make whatever he, she (or it) likes with the rods, this is not a license to disturb others or destroy their work!

Circulate among the children, encouraging creative activity and further exploration. Let the children talk among themselves about their designs if they like. You should also take the opportunity to ask some questions in a casual way about number, color, and so on. Here are some examples of such interactions:

T: Florence, you have made a beautiful picture. It makes me think of a flower. Can you make another one just like it over here?

T: Gertrude, you have made a beautiful pattern that uses all of the rods. And all the rods of the same color are together. That's a wonderful way to organize all of the rods. Can you think of another way to make a pattern that uses all of the rods?

T: Horace, you told me that this is a train. I see you have used several colors. Do you know what color this is?

If Horace makes a mistake or doesn't know, either ask the class if someone else knows or give him the correct information yourself:

T: This is a yellow rod. Is there another yellow rod in your train, Horace?

T: Irene, I see that you have put all your orange rods together to make a beautiful wall (or carpet). Do you know how many orange rods you have in your wall?

If she doesn't know, count them with her.

T: Sean, you have built a staircase. What color is the lowest step? What color is the highest step? Let's imagine a little mouse climbing the steps. Let's count the steps as he goes.

Start counting with the child.

If you feel that Sean would not find it too difficult, you could also try counting backward with him as the mouse comes back down the staircase.

EARLY WARNING:

Lesson K3 suggests that you use counting songs. If you don't know any such songs, you will need to familiarize yourself with one or two, or obtain appropriate recordings, before teaching that lesson.

54

TITLE: Number Readiness #1

INTRODUCTION:

There is tremendous variation from one Kindergarten class to another when it comes to the children's knowledge about numbers. In one class, most of the children might have had home backgrounds or nursery school experiences which have provided them with a good knowledge of numbers. In another class, most of the children might not even be aware that they have ten fingers.

Numbers play a (usually casual) role in just about every CSMP Kindergarten lesson. However, because of the situation described above, as far as lessons aimed specifically at counting and number readiness are concerned, you are the only one who can judge whether or not a given exercise is appropriate for your children, and at what time of year that exercise should be scheduled. Therefore, we strongly recommend that the number readiness activities scheduled in this teacher's guide be considered merely as suggestions.

If you think that the exercises suggested in a particular Number Readiness lesson are unsuitable for your group of students, you could select activities that are more appropriate from some other Number Readiness lesson or from one of the collections of supplementary activities that are found in Section Four of this guide:

S1: Numeral-writing
S2: Arrows
S3: Exercises in listening
S4: Small group activities.

These collections include activities which range from the simple to the very challenging. With these activities at your disposal you should have less difficulty in adapting the Number Readiness activities to the level of your class.

SUGGESTED ACTIVITIES:

A. Counting Songs

MATERIALS:

Teacher - (Optional) Recordings of counting songs*

Students - None

DESCRIPTION OF ACTIVITY:

Counting songs are commercially available on tape or record. In these recordings, the children are usually asked to show the numbers with their fingers as the song proceeds.

Examples: "Ten Little Indians"

"The Twelve Days of Christmas"

B. Inside the String

MATERIALS:

Teacher - Yardstick*, ruler*, straight edge* or pointer*

Students - None

DESCRIPTION OF ACTIVITY:

Make sure all the children are seated.

T: With this stick I am going to trace a string around some of you. When I give the signal, I want the ones who are inside the string to stand up. Then I want everyone else to show with their fingers how many children are inside my string.

Once the children have become familiar with this activity, you might like to make it more challenging by asking the "outsiders" to show the number with their fingers before those children who are inside the string stand up.

IMPORTANT NOTE:

In this activity the students are asked to answer simultaneously by showing a number of fingers. Another way to give everyone a chance to answer to a question directed to the full group is to train your students to MOUTH THE ANSWERS without making a sound.

This technique is especially useful when the answer is short and can easily be lip-read (e. g., a number, a "yes," a "no"). Feel free to use it frequently. When your students are used to this technique, you will merely have to say "mouth the answer" and perhaps make a gesture pointing to your lips and they will get the message.

K4

TITLE: Ducks

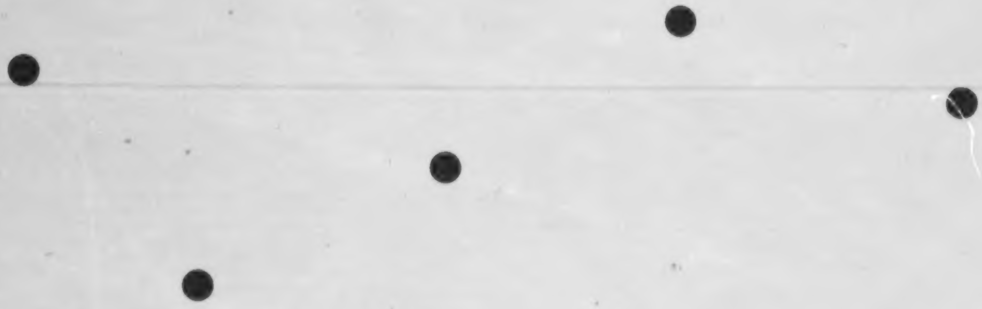
MATERIALS:

Teacher - Colored chalk*

Students - None

DESCRIPTION OF LESSON:

Draw five dots on the board as follows:

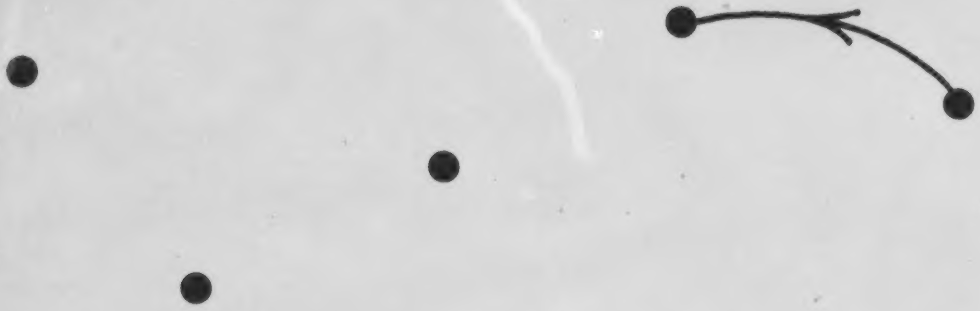


T: Today the dots will be for ducks. How many ducks are there?

Let the children show the number with their fingers. Ask someone to count the ducks, point to a "5" in the Numeral Row, and write a "5" on the board.

K4

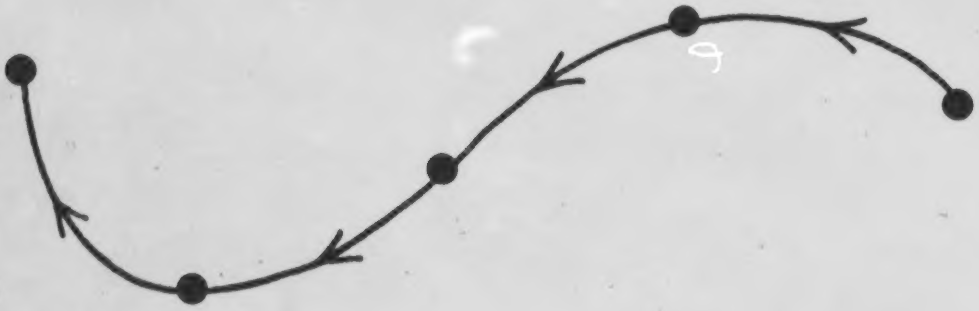
Draw the following arrow in a bright color:



As you draw this arrow (from right to left), say:

T: This duck is swimming right behind this one.

Complete your picture by drawing the remaining three arrows, as follows:



T: Are they swimming in this direction (point to the left) or in that direction (point to the right)?

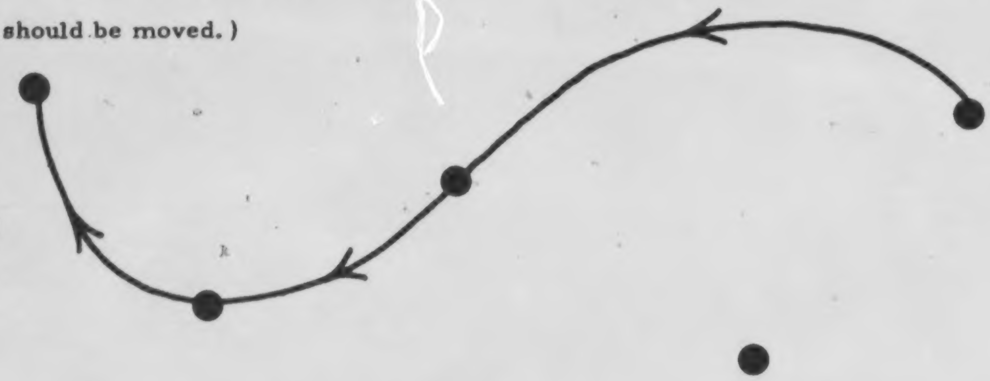
Since many of your children may not be familiar with the precise meaning of phrases such as "behind," "in front of," and "in between," you may wish to let them act out this situation. Sometimes, this sort of active participation helps to clarify the usage of words.

T: In my picture the mother duck is swimming at the front. (Ask someone to point to the mother.) The father duck is swimming at the back. (Ask someone to point to the father.)
The baby ducks are in between their mother and father. How many baby ducks are there?

Ask someone to point to them. Then ask someone to point to the first duckling, to the second one, to the third one.

T: Now close your eyes.

Change your drawing. (Except for the "lost duckling," none of the other dots should be moved.)



K4

Let the children react. They will probably notice that one duckling got out of line, or lost his way.

Ask someone to point to the lost duckling. Ask how many ducklings are still with their parents.

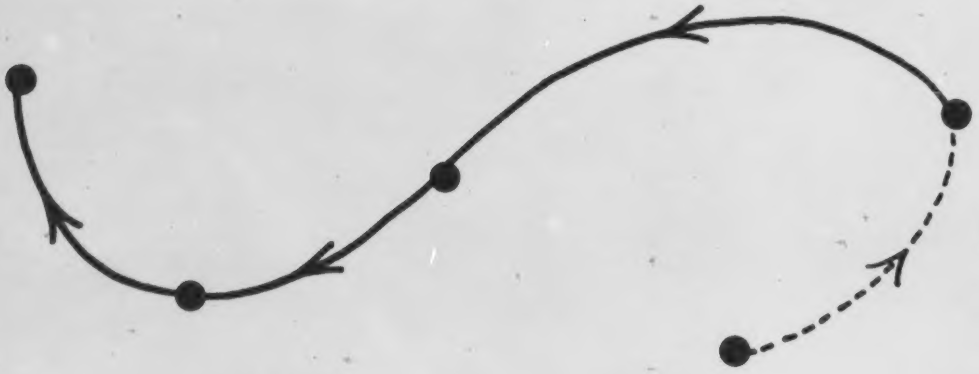
T: What can we do so that the lost duckling finds his family again?

Your students will probably come up with many very good ideas. Here are some possibilities:

S: Erase this picture and draw the first picture again.

T: I would like to solve the problem without drawing the whole picture over again.

S (Tracing the dashed arrow): You could draw this arrow:



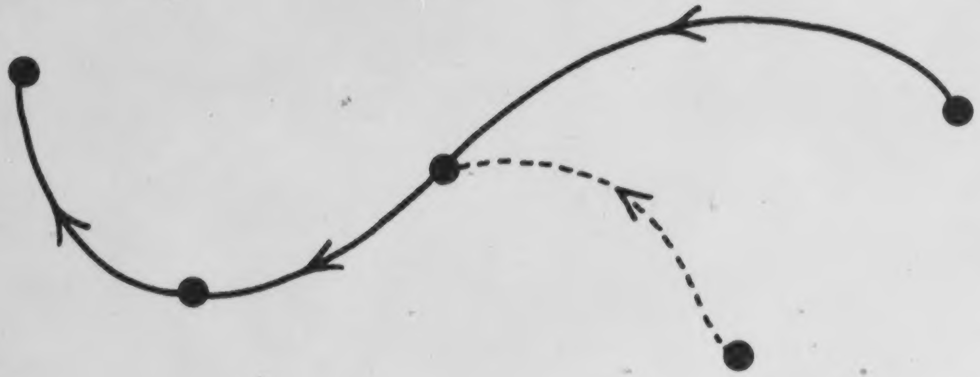
It shows that the baby follows its father.

T: That's a good idea. Can anyone suggest how the baby could end up in front of his father?

S: Draw this arrow (the same as in the picture on the previous page), let the last dot be for the "father" and the next one be for the "baby duck" that was lost.

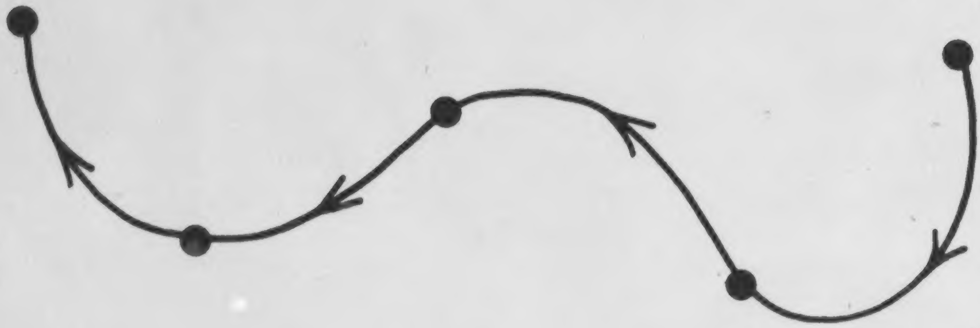
T: Very good.

S (Tracing the dashed arrow in the picture below): You could draw:



Without changing the position of the dots, improve this suggestion yourself by drawing the following:

K4



Trace along the arrows with your finger or a pointer and say:

T: The father swims right behind this duckling; this duckling swims behind this one; . . . and so on.

EARLY WARNING:

Lesson K6 calls for a magnetic board. See the note in the lesson for details.

TITLE: Centimeter Rods #2 (Free Play)

Repeat Lesson K2.

TITLE: Number Readiness #2

SUGGESTED ACTIVITIES (see the introduction to Lesson K3):

A. Happy Fish

MATERIALS:

Teacher - Magnetic board* (see the note below); demonstration Minicomputer checkers; colored chalk*

Students - None

IMPORTANT NOTE:

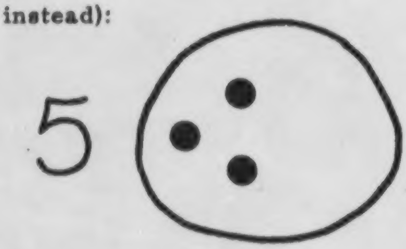
Several lessons in the Kindergarten program call for a magnetic board. More or less any large metallic surface can serve this function, although some are more easily manageable than others. The simplest solution would be if one of your chalkboards were magnetic, so test them with one of the demonstration Minicomputer checkers. If the results of this test are negative, try to locate a portable chalkboard which is magnetic. Failing that, test all the likely surfaces in your room (for example, the side of a filing cabinet, the door of a closet, etc.). As a last resort you should try to obtain a large sheet of metal. (Make sure the metal is indeed magnetic; aluminum alloys, for example, are not.)

In some of the lessons which involve a magnetic board it is required that you be able to write on it. If your magnetic board is a chalkboard this will cause no problem. If this is not the case, we suggest you tape a large sheet of paper (no heavier than 70 pound) over your magnetic board, and use magic markers to write on it. Sheets of paper from a large easel pad are most suitable for this purpose. In case a lesson calls for any erasing to be done, you should have available several clean sheets of this large paper, so that you can tape up a fresh one (after having removed the first one) as the need arises. Furthermore, whenever a lesson that makes use of a magnetic board also calls for colored chalk, you should interpret that as a call for magic markers. We suggest that, if your magnetic board is not already a permanent feature of your classroom (e.g., a chalkboard), you leave it permanently in place throughout the year.

DESCRIPTION OF ACTIVITY:

T: One of my friends owns a pet shop which specializes in all kinds of fish. As you know, fish need to have a reasonable amount of water and swimming room if they are to be healthy and happy. So, my friend is very concerned about how many fish there are in each bowl. He has decided that there should be exactly five fish in each bowl. (Write "5" on the board.) There is only one problem. My friend has a niece, Jody. She loves to help him clean out the bowls and change the water . . . but she can't count very well. Look, here is the first bowl she cleaned yesterday.

Draw a string on your magnetic board and place magnetic checkers in it (if this is not possible, draw the string and the appropriate number of dots on the chalkboard instead):



The children will probably notice that this bowl doesn't contain five fish. Ask them if they can help Jody. (Have additional checkers available.) If necessary, ask questions such as:

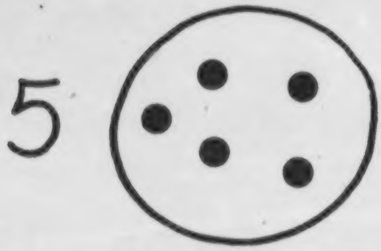
T: How many fish are there in this bowl?

S: Three.

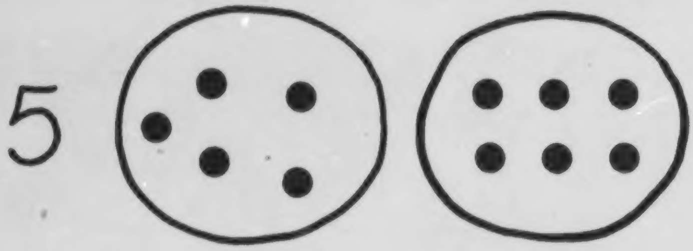
T: Is that too many or not enough?

S: Not enough.

T: Add some more fish so that there are five in the bowl.



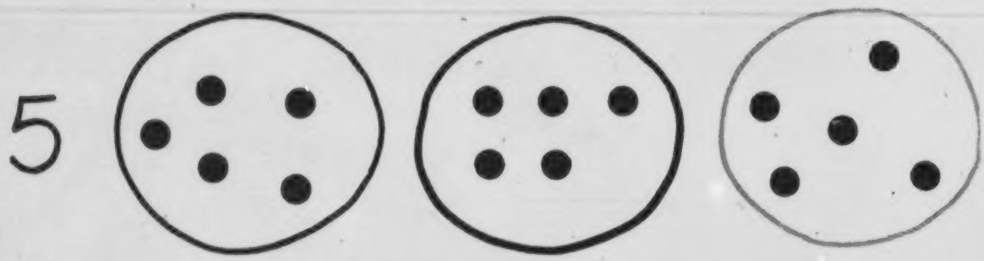
When this has been done, draw a second bowl:



T: Here is a second bowl. What do you think about this one?

S: There are too many fish in it. One should be taken out.

When this has been done, draw a third bowl:



S: There are five fish in that bowl. That's OK.

If a mistake is made at any point, correct it by asking the child to count the checkers in the string being discussed.

B. Number Contest

MATERIALS:

Teacher - Demonstration Numeral Cards; Demonstration Dot Cards

Students - None

DESCRIPTION OF ACTIVITY:

A volunteer chooses a numeral card or a dot card and shows it to the class. Then he or she has to read it, tap that many times on the desk, and find the numeral on the classroom number line or in the 0-99 Numeral Chart. If these tasks are performed correctly, the volunteer chooses the next player. If a mistake is made, the student who spots it has the next turn. (If no student notices the mistake, you should designate the next player after having pointed out the mistake.)

K7

TITLE: "81 Roses"

MATERIALS:

Teacher - One copy of the storybook, "81 Roses"

Students - One copy of the storybook, "81 Roses," for each pair of students

DESCRIPTION OF LESSON:

Although "81 Roses" uses the mathematical languages of dots, arrows, and strings, it is really a story, in the true sense of the word. And that's how it should be read to your class. Forget that the book is part of a mathematical curriculum.

You may wonder why this storybook (among others) is included in our curriculum. Part of the reason is that it is our intention to leave the students with the impression that these mathematical languages are powerful, useful, and as natural as their own mother tongue. On the other hand, we believe that there is room in the world of mathematics for expressing the emotions and for giving free rein to children's wonderful imagination.

We suggest that, for this particular book, you do not give your students copies of the book right at the beginning of the lesson. Experience has shown this to be more distracting than useful. You should take care, however, as you are reading the story, to give the children an opportunity to look at the realistic pictures in the book by holding up your own copy for them to see at the appropriate moment. If, on the other hand, you wish them to focus on a particular mathematical picture, it is very easy to copy it onto the board.

Here are some suggested questions you may wish to introduce as you are reading the story. (If you do this, be careful not to destroy the atmosphere of the story.)

page 5:

T: The blue arrow tells you that the dog is following his mother. Point to the dog. Point to the mother.

page 7:

T: How many dots are there in the blue string? Who are they for?

page 11:

T: Can you find the number 37 on this page? What are the other numbers?

pages 12-13:

Ask the children to count how many cookies there are, point to the stolen cookies and count how many cookies were left over. You could ask them to illustrate this part of the story with their fingers.

page 15 or page 17:

This would be a good place to stop the story if you feel it is too long for your class to take at one sitting. You can always finish reading it another time. If you break the reading of this story into two sessions, before you start reading on the second occasion, be sure to ask the children what they remember about the story from the first session.

page 18:

Ask a child to point to the mother and to the dogs.

page 19:

Ask a child to point to the mother and to the little dog.

page 20:

T: How many dots are there in the blue string? Who are they for?

page 22:

T: Do you have any idea how old the little dog's mother is now?

If nobody knows, tell the children to be sure to pay close attention as you continue to read the story, so that they can find out.

When you have finished reading the story, don't rush the children into another activity. Instead, give a copy of the storybook to each pair of children and let them look at the pictures at their own pace. Make them feel free to talk about the story (with you or with their partner), or to make a drawing about it if they wish. Your children would enjoy it greatly if they were able to have a copy of the storybook to keep. This can be arranged if your school is prepared to buy sufficient additional copies of the book so that you have one copy for each child. However, if it is not the intention of your school to purchase a new set of storybooks each year, once your children have had ample opportunity to look through the book, collect them in so that they can be reused next year.

There is a narration tape[*] available for the story "81 Roses." On some other occasion, you could listen to it as a class, or you could let the children listen to it individually at any time during the year. In any case, at least one copy of this storybook (with or without the accompanying tape) should be available for children who wish to glance through it in their spare time.

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[*] This tape may be obtained by sending a blank 30-minute cassette tape to CEMREL-CSMP. The recorded tape will be returned to you free of charge. Please be sure to mention the title of this story in your request for the tape to be recorded, and include a stamped, self-addressed envelope.

K8

TITLE: K - A Blocks #1 (Free Play)

MATERIALS:

Teacher - None

Students - One set of K - A blocks per child

IMPORTANT NOTE:

If you have available enough sets of commercially made wooden or plastic attribute blocks that each child can have a set, feel free to use them in this and all future K - A block lessons. On the other hand, if you only have a small number of such sets, do not give them to the children in lessons when everyone needs a set. However, you should feel free to use a commercial set at any time when we ask that you have one for yourself, provided that there is a reasonable match between the attributes of your set and those of the children's sets.

In most lessons we are only concerned with the following three attributes: color, size, shape. If your set includes both thick and thin blocks, use only the thin ones or only the thick ones.

Two lessons (K8 and K11) are scheduled for free play with the K - A blocks. Feel free to devote additional time to this topic if you think your students would find it useful.

DESCRIPTION OF LESSON:

Give each student a set of blocks and make sure they all have a flat surface (desk, table or floor) on which to work.

Explain to them that they should simply play with the blocks and that you would like them to create some beautiful designs. You may want to remind the children that they should be careful not to disturb others or interfere with their work.

Circulate among the children, encouraging creative activity and further exploration. If the children want to talk (with you or with their friends) about what they are doing, they should be free to do so.

As you are walking around the room, you should make a point of asking some questions in a casual manner but in a spirit of genuine curiosity. For example:

T: What color is this piece?

Does this piece have corners?

How many sides does this piece have?

Does this piece have the same number of sides as it has corners?

Which of these two pieces has more sides?

Which of these two pieces has fewer corners?

Can some of these pieces be put together to fit onto this piece? How many?

Are all the sides of this piece the same size?

Are all the corners of this piece the same size?

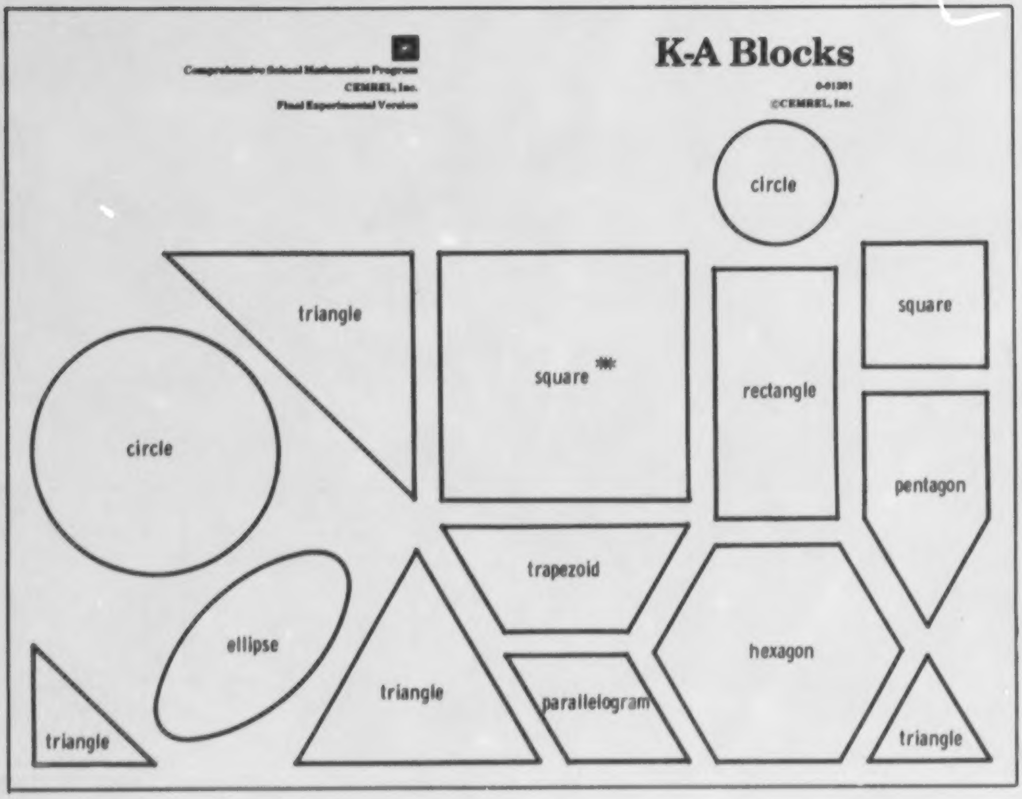
In addition, here are some other points to be aware of:

- A student may ask you what a certain shape is called. If this happens, you should simply give him the information desired.

- A student may volunteer a name for a shape. If the name is correct, the student should be praised. If the name is original, comment that, although the student's invention is interesting, the shape does have a common name and give that name to the student.
- If a student uses, for example, the name "triangle" when referring to a square, give him or her credit for being aware of the word "triangle" and then correct the confusion.

The free play activities should include some drawing and coloring. The drawings may be freehand, or the children may wish to trace around the blocks as if they were stencils, or to use a punched-out sheet as a template. Individuals may be left undirected or may be guided at your discretion. Possible directed activities include drawing different shapes, but coloring them in a given way (green circles, blue triangles, etc.), or reproducing just one shape several times, varying the pattern with different colors.

There are plenty of other excellent activities that make use of the K - A blocks to promote the students' artistic expression. For example, if you trace around the shapes, cut out what you have traced and arrange these cutouts into a design, you can use the design to make a beautiful spatter painting.


Comprehensive School Mathematics Program
CEMREL, Inc.
Final Experimental Version
K-A Blocks
0-01201
©CEMREL, Inc.
circle
triangle
square *
rectangle
square
circle
pentagon
trapezoid
ellipse
hexagon
triangle
parallelogram
triangle
triangle

In this representation of a K - A block sheet, the names of the shapes are given for your information only.

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* It is imprecise but not incorrect to refer to a square as "a rectangle."

EARLY WARNING:

Lesson K9 calls for six identical large objects, such as six bricks or six short planks.

K9

TITLE: Ways to Make Six

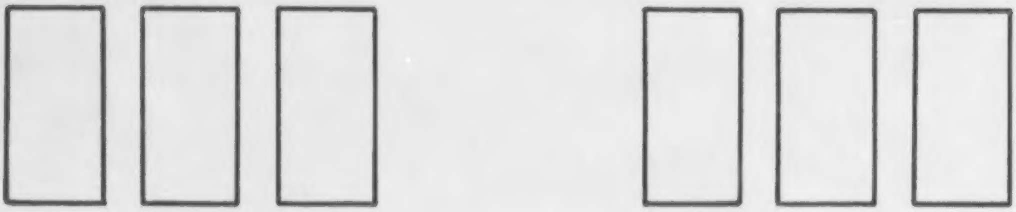
MATERIALS:

Teacher - Six identical large objects,* such as six bricks or six short planks

Students - None

DESCRIPTION OF LESSON:

Put the six bricks on the floor, in two groups of three.



Seat the children in such a way that they can all see the bricks. For example, they might be seated on the floor in a big circle around the bricks. Ask them what they see. Eventually, you will get the response that there are six bricks, "three over here and three over there."

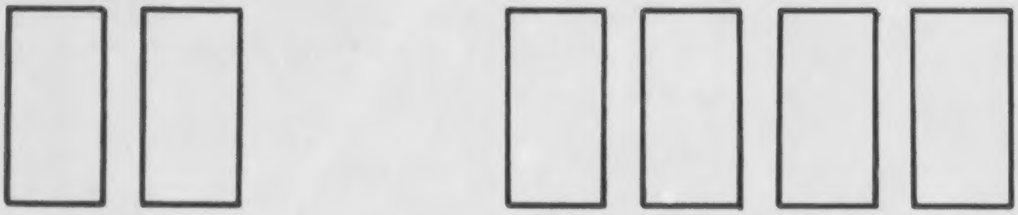
Write the following on the board:

$$\begin{array}{c} 6 \\ 3 + 3 \end{array}$$

(read this, "Six is three plus three.")

T: Can anyone rearrange these bricks in another way?

Let's suppose a child arranges the bricks like this:



T: How many bricks are there over here? (Two)

And how many over here? (Four)

How many altogether? (Six, just as there were a moment ago)

Add this information to your record on the board.

6
3 + 3
2 + 4 (read this, "Six is two plus four.")

There are, of course, many ways to make six.

Here are some of them:

6+0	3+3	2+2+2
2+4	1+2+3	1+1+4
4+2	3+1+2	1+1+1+1+1+1

Stringently avoid succumbing to the temptation to see if the children can find all the possible ways!

If you want your children's future enjoyment of this activity to be ensured, the secret is to stop it while their interest is still high.

To bring the activity to an end, you could say:

T: Look at all the different ways we have found of writing 6.
Let's read them together.

IMPORTANT NOTE:

This lesson is going to be referred to later on in the schedule.

If you see, for example,

TITLE: Ways to Make Eight

Repeat Lesson K9

the intention is for you to follow this same lesson plan, but using eight objects rather than six.

K10

TITLE: **Squirrels and Nuts**

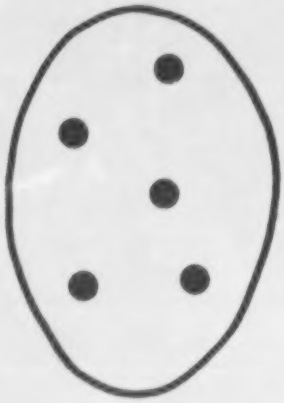
MATERIALS:

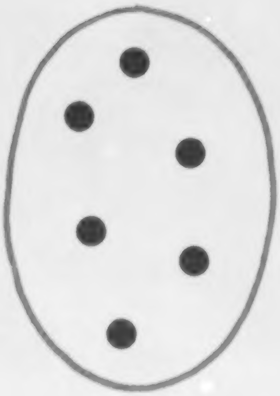
Teacher - Colored chalk*

Students - None

DESCRIPTION OF LESSON:

Draw the following on the board:





T: In the blue string there are some squirrels.

In the yellow string there are some nuts.

How many squirrels are there? (Five)

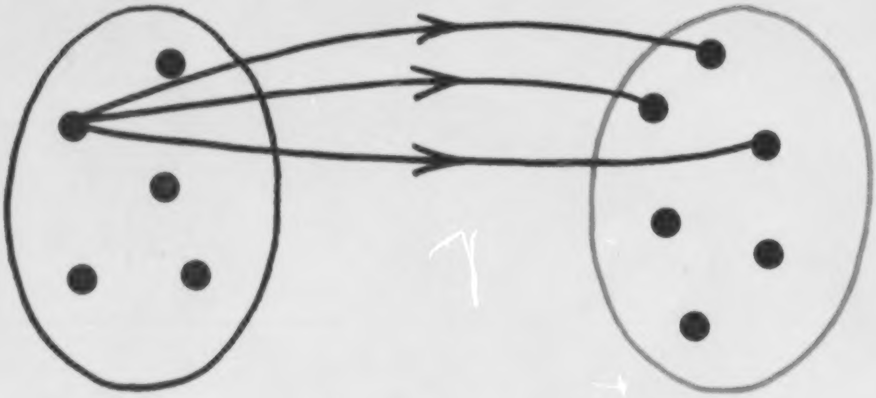
How many nuts are there? (Six)

Let the students count the dots, show the numbers with their fingers, point to the numerals in the Numeral Row, and write them on the board.

T: Squirrels usually like nuts, don't they? Ann, would you come and point to a squirrel. That squirrel eats three nuts.

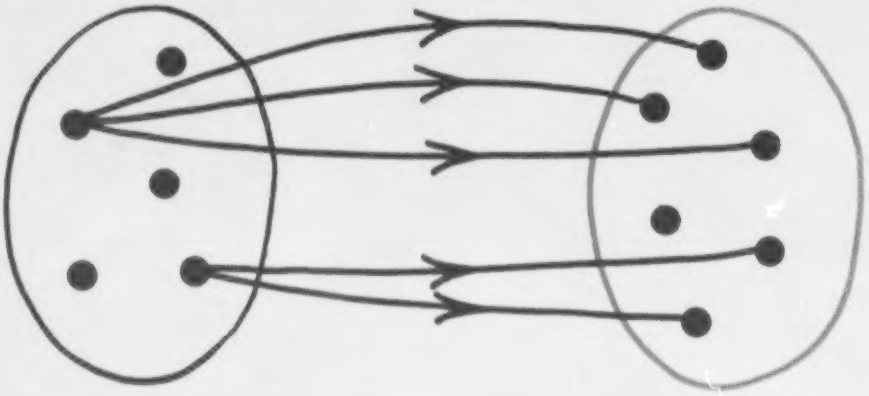
Let Ann trace the arrows that show the squirrel eating the nuts. Let her have

complete freedom in choosing which nuts. Then you should draw in the three arrows yourself.

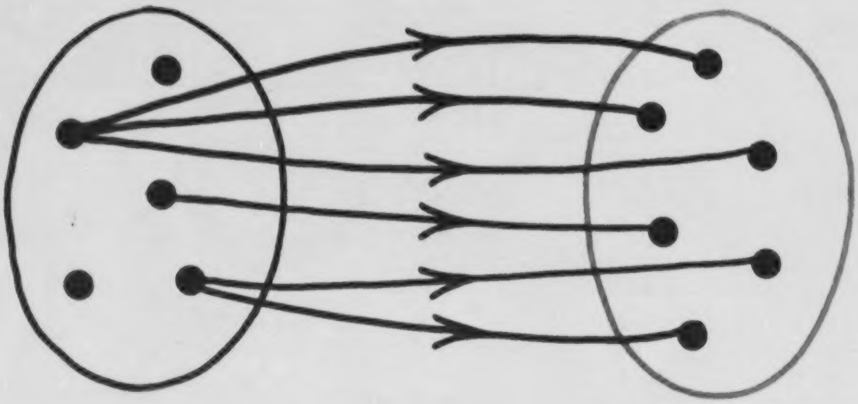


T: Steven, point to another squirrel, please. How many nuts do you want him to eat?

Suppose Steven says, "Two."



T: Sam, would you point to another squirrel. How many nuts are left for him to eat? (One)



IMPORTANT NOTE:

Since you are allowing your children complete freedom as they point to the squirrels and the nuts, your drawing will probably look quite different from the one above. Try, however, to keep it clear and, if possible, avoid drawing arrows which cross each other.

Ask various questions about your arrow picture. For example,

T: Did all the squirrels eat some nuts? (No)

How many did not? (Two, maybe they were not hungry.)

How many squirrels in our story do we know for sure were hungry? (Three)

Are there any nuts left? (No)

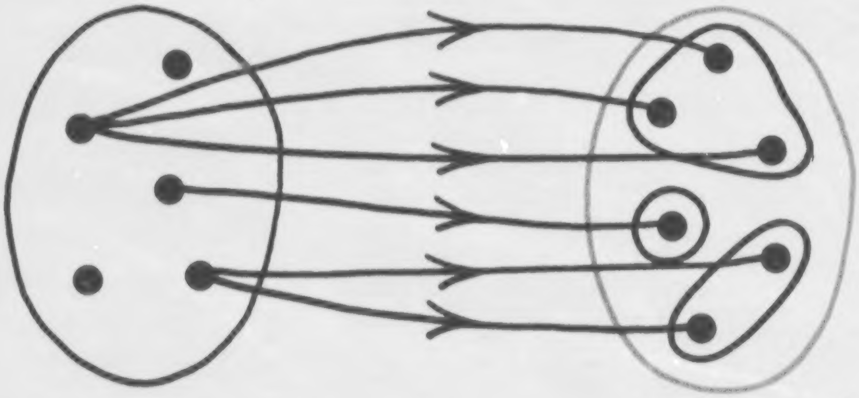
(Point to a squirrel) How many nuts did this squirrel eat?

(Point to a nut) Who ate this nut?

Which squirrel ate the most nuts?

Of all the squirrels who ate some nuts, which one ate the fewest?

If your class is still interested, you could ask certain children to trace a string around all the nuts that were eaten by a given squirrel. If you do this for each squirrel in turn, your final drawing will look like this:



K11

TITLE: K - A Blocks #2 (Free Play)

Repeat Lesson K8.

TITLE: Number Readiness #3

K12

SUGGESTED ACTIVITIES (see the introduction to Lesson K3):

A. Don't Make a Sound

MATERIALS:

Teacher - Demonstration Numeral Cards

Students - None

DESCRIPTION OF ACTIVITY:

Draw a dot picture on the board. Display the numeral cards one by one. The students should not make a sound until the matching card is shown. But when the matching card is shown they should call out, "That's it!"

Variation:

Write the numeral on the board. Show the Demonstration Dot Cards one by one.

B. Rhythm

MATERIALS:

Teacher - None

Students - None

DESCRIPTION OF ACTIVITY:

Tap a sequence of sounds on a student's desk. One of the students has to reproduce the sequence exactly (by tapping on his or her desk), while the class listens to check the answer.

Variation:

Tap the sequence of sounds. Then everyone together says how many times you tapped.

K13

TITLE: Reindeer and Sleighs

MATERIALS:

Teacher - Colored chalk*

Students - None

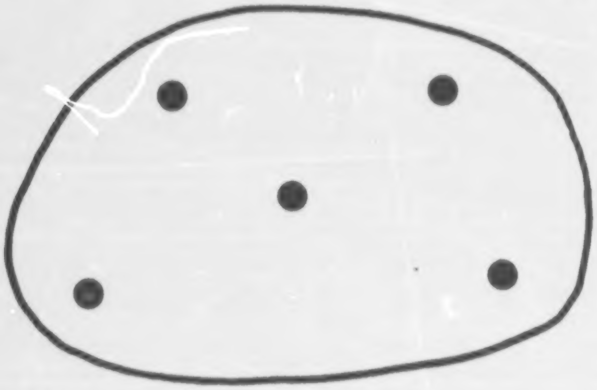
IMPORTANT NOTE:

Remember to make a big drawing; spread the dots out across the entire board; draw long arrows; make sure that all arrows and strings are clearly visible.

DESCRIPTION OF LESSON:

Begin by talking briefly with the children about reindeer and sleighs.

Then draw the following on the board:



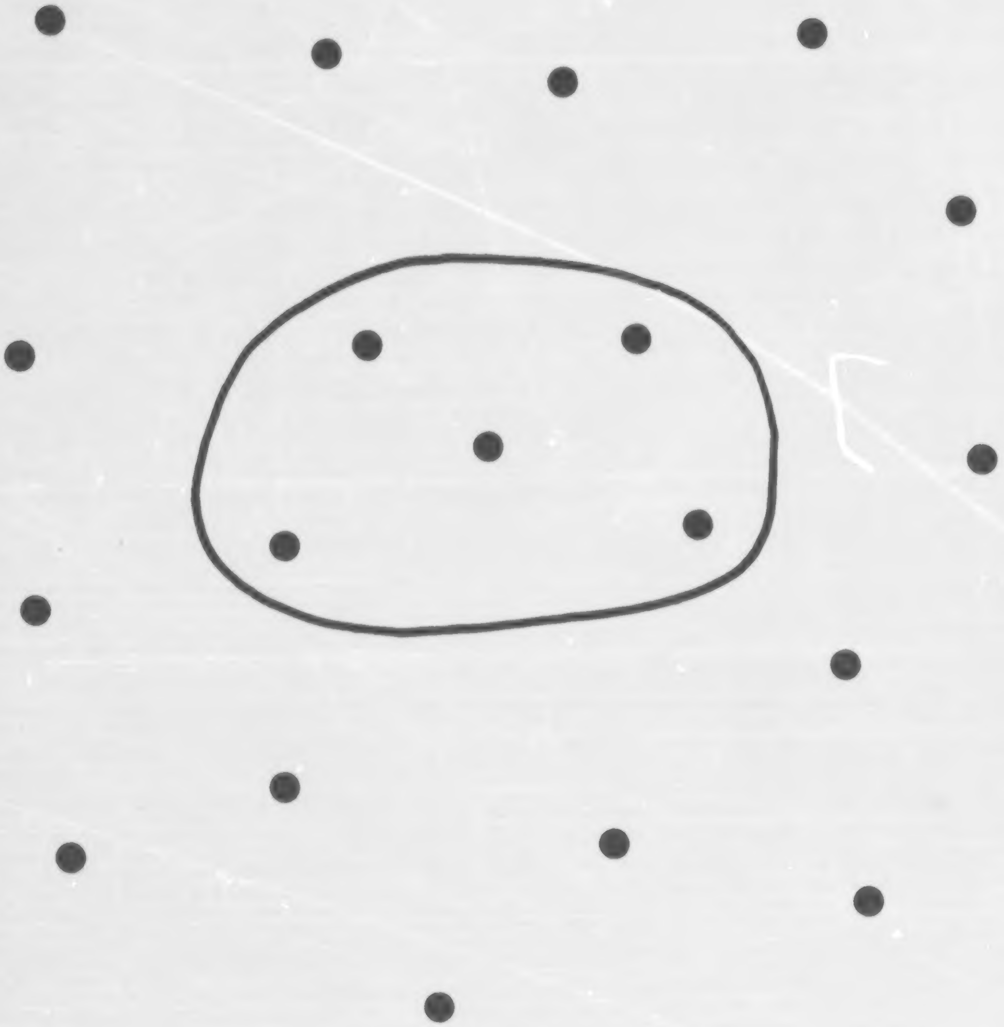
T: These dots are for sleighs. How many sleighs are there? (Five)

Encourage the children to answer without counting. Then let someone check by counting. Finally, ask someone to point to "5" in the Numeral Row.

K13

T: And the dots I'm just going to draw outside the red string are for reindeer. Count them as I draw.

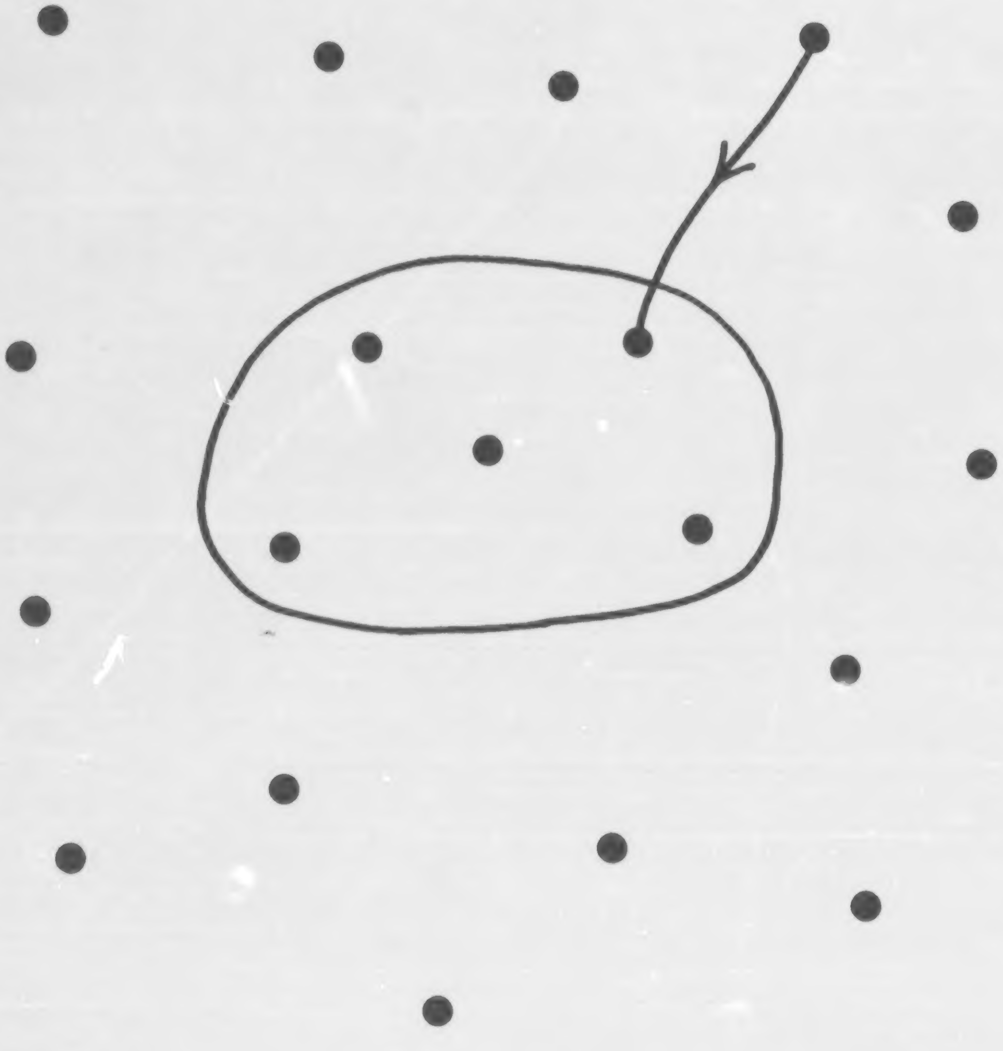
Draw the following 14 dots outside the red string:



T: How many reindeer are there? (14)

Ask someone to check this answer and then to point to "14" in the Numeral Row.

Draw this blue arrow:

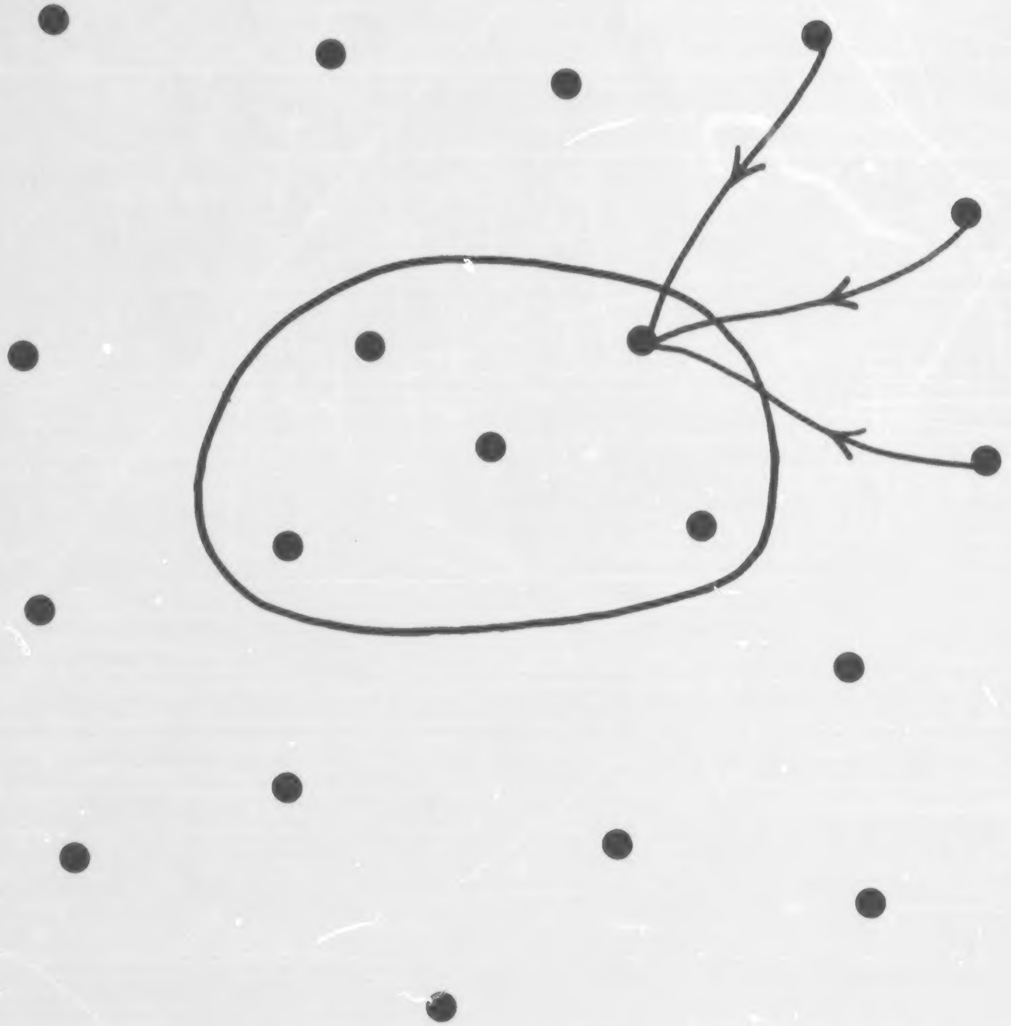


As you draw the arrow, say:

T: This reindeer is pulling this sleigh.

K13

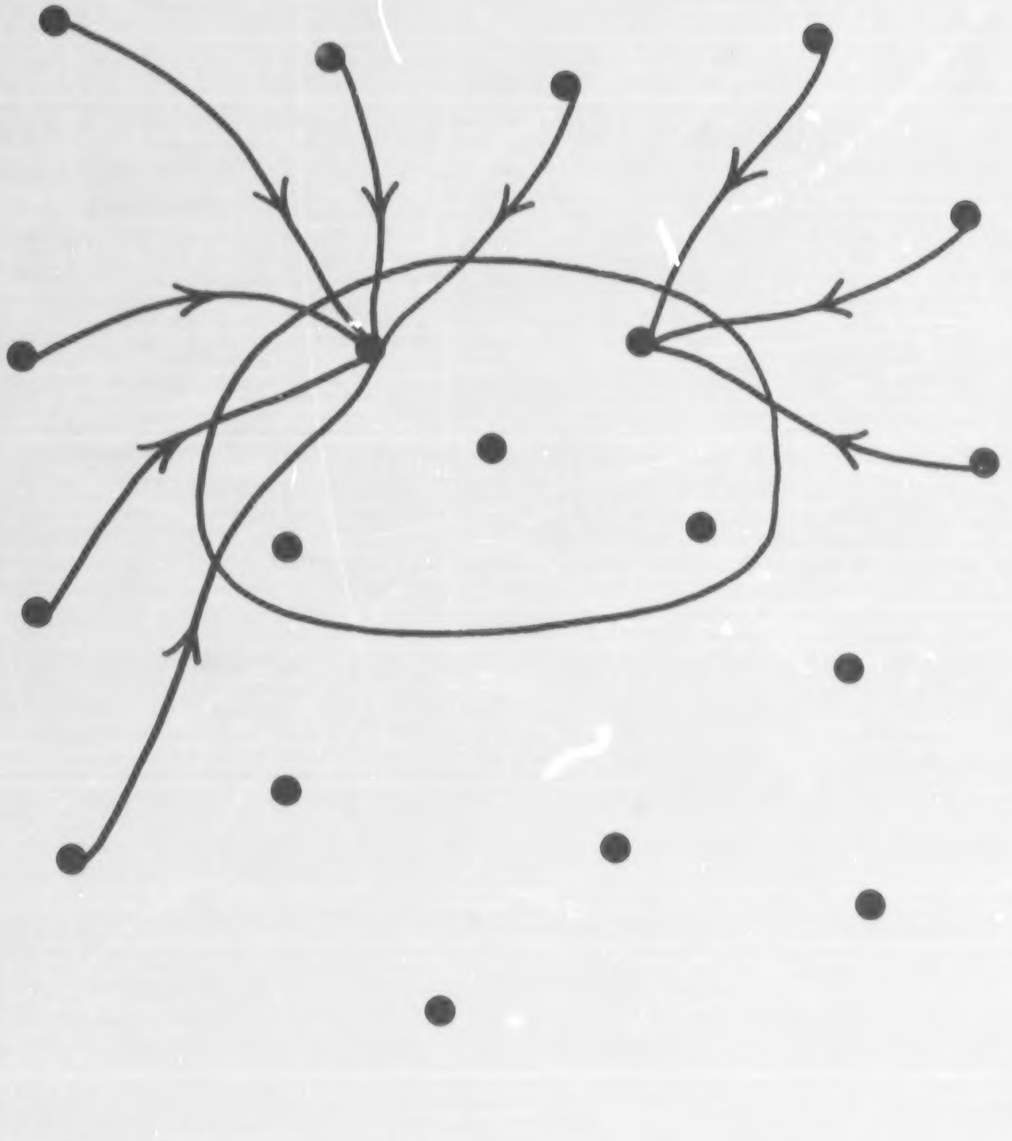
Add arrows to your drawing one by one, pausing after each group of arrows to ask appropriate questions. For instance:



T: How many reindeer are needed to pull this sleigh?

S: Three.

Draw the next group of arrows:

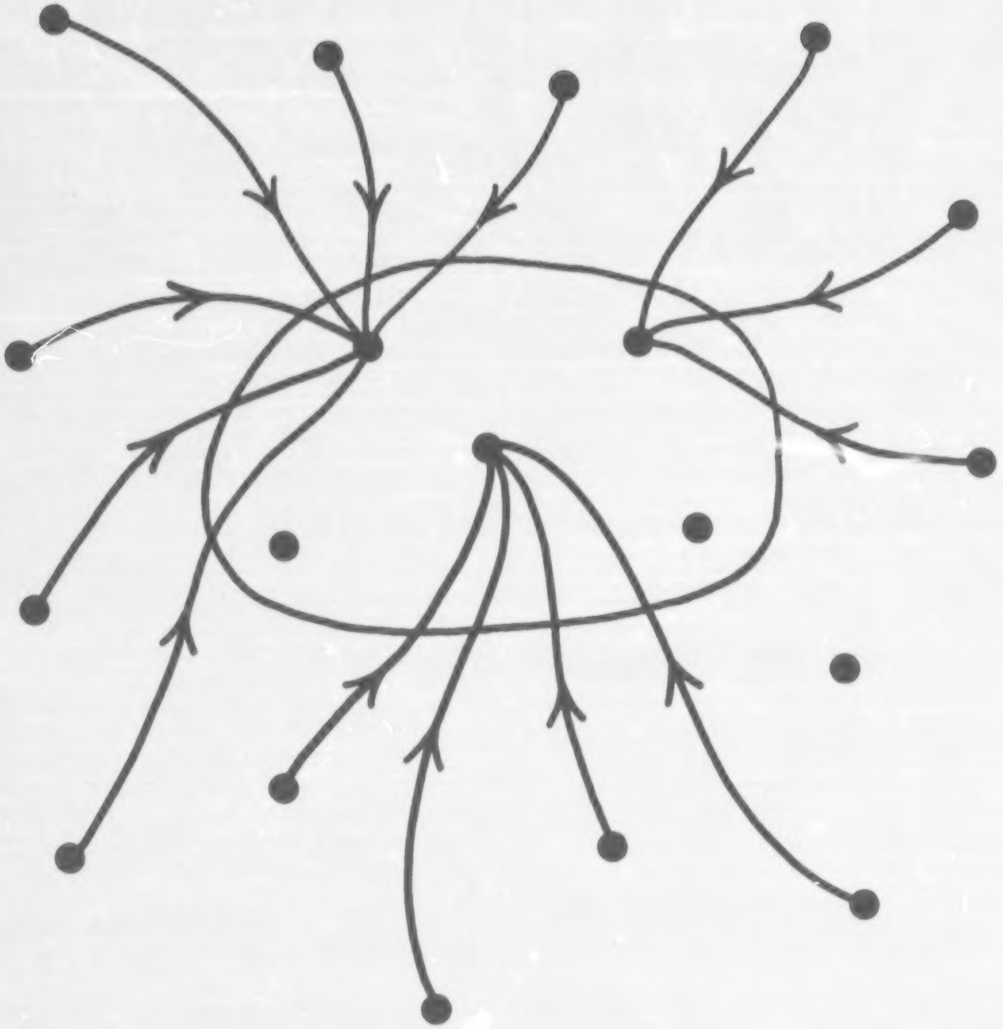


T: What about this other sleigh?

S: That one needs six reindeer.

K13

And finally:



T: How many reindeer are needed to pull this sleigh?

S: Four.

Ask various questions about this arrow picture. For example:

T: This is a reindeer. Which sleigh is he pulling?

This is a sleigh. How many reindeer are pulling it?

Is every reindeer working? (No, one is not.)

Is every sleigh being pulled? (No, two are not.)

How many sleighs are being pulled? (Three)

How many sleighs are there altogether? (Five; two plus three.)

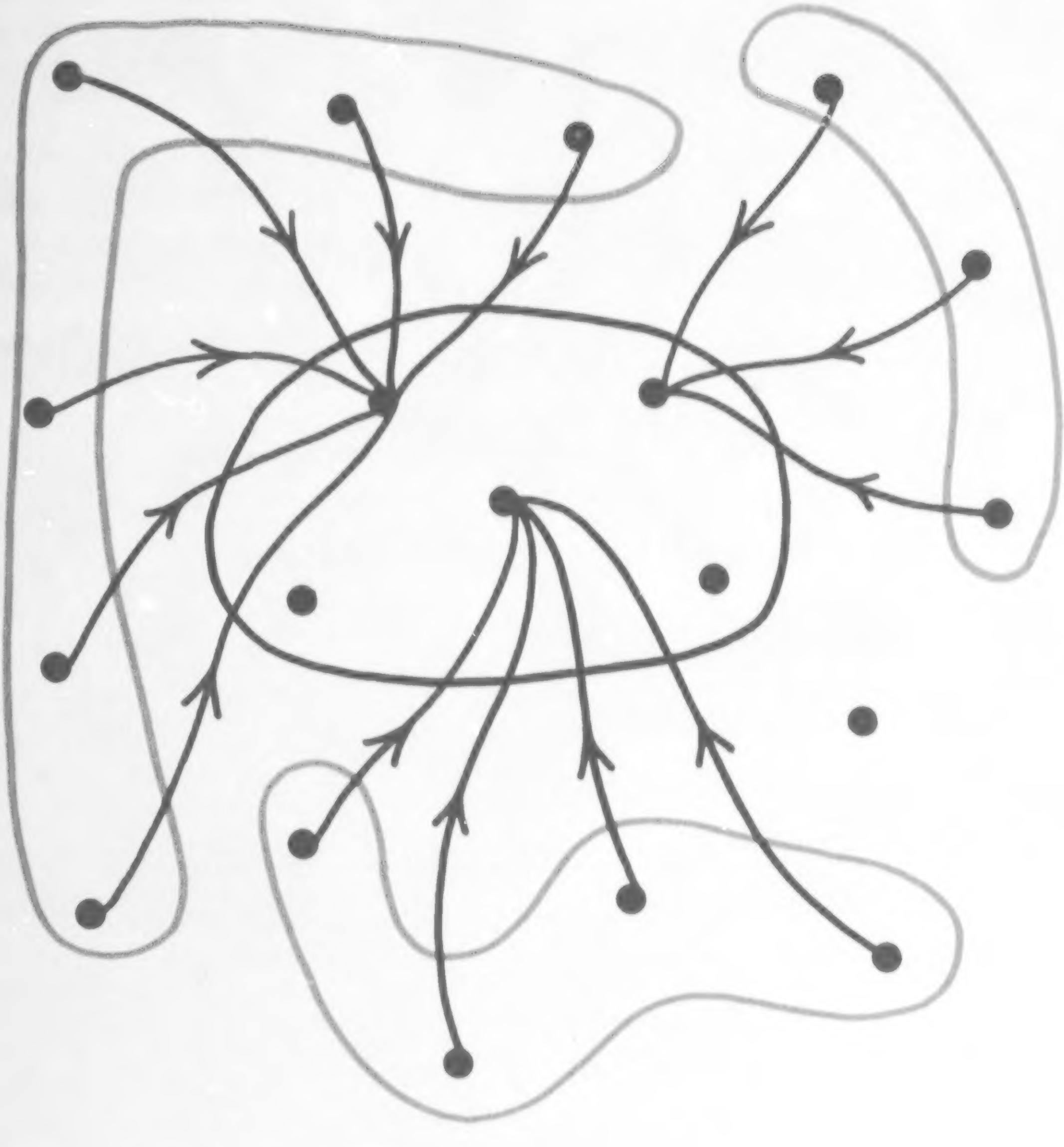
Of the sleighs being pulled which one seems the heaviest? (The one that needs the largest number of reindeer to pull it.)

Which one seems the lightest? (The one that needs the fewest reindeer to pull it.)

If your class is still interested you might ask one of your children to trace one string around all the reindeer pulling a certain sleigh. Once it has been traced correctly, draw in the string yourself.

If you do this for each sleigh, the picture on your board will end up looking like this:

K13



93

TITLE: Centimeter Rods #3

MATERIALS:

Teacher - None

Students - A set of centimeter rods* per one, two or three children

DESCRIPTION OF LESSON:

Activity 1:

Begin with a short period of free play with the rods. After 5-10 minutes, ask the children to stop what they are doing and to listen to you. Then proceed with Activity 2.

Activity 2:

T: Put all the rods in front of you.

I am going to ask you to show me some of the rods.

When I do that, hold up the rods I ask for so that I can see them.

Ask the children to show you various selections of rods, one after another. Vary the sorts of descriptions you use. For example:

T: Show me one red rod

one yellow rod and one black rod

two light green rods

the shortest rod

the longest rod

two rods that have the same color

two rods that have the same length.

Hold up a brown rod. Now find a rod that is shorter than the brown one.

Activity 3: Feel the Rods.

Ask the children to put away all their rods except for:

one white rod

one red rod

one light green rod.

They are to hide these three rods behind their backs, and then whenever you ask for one of the three rods they are to locate that rod by touch alone.

T: Show me the shortest of the three rods

the longest of the three rods

the red rod

the white rod.

Here is a riddle: I am not the shortest of these three rods. I am not the longest of the three rods. Find me.

If the children seem to enjoy this last exercise, you could repeat it with three other rods.

K15

TITLE: The Zoo

MATERIALS:

Teacher - Colored chalk*

Students - (Optional) Worksheets K15-I, II

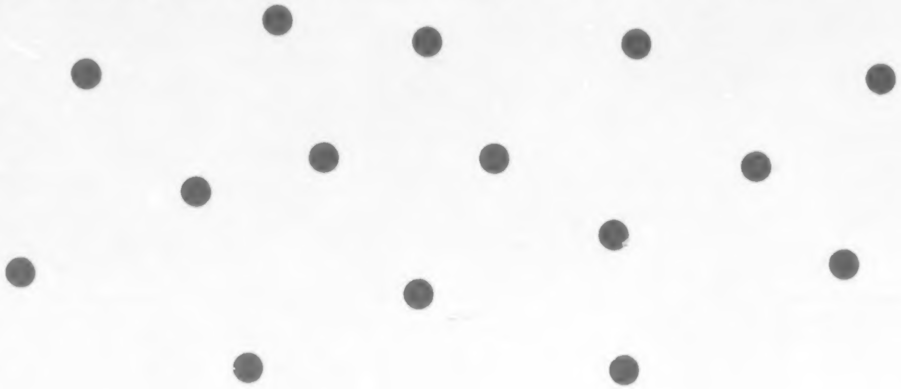
DESCRIPTION OF LESSON:

Start the lesson by discussing a nearby zoo in an informal manner.

T: I am going to draw some animals in a zoo.

Count them in your head as I draw them.

Draw the following 15 dots, well spread out across your board:



T: How many animals are there? (15)

Ask some of the children who did not answer this question correctly to come to the board and count the dots, using a pointer to indicate each dot as it is counted. Encourage different children to start counting from different dots. Allow the rest of the class to give verbal assistance to the one who is doing the counting.

K15

T: There are 15 animals.

How many fingers do you have?

How many children do we need so that we can show 15 fingers?

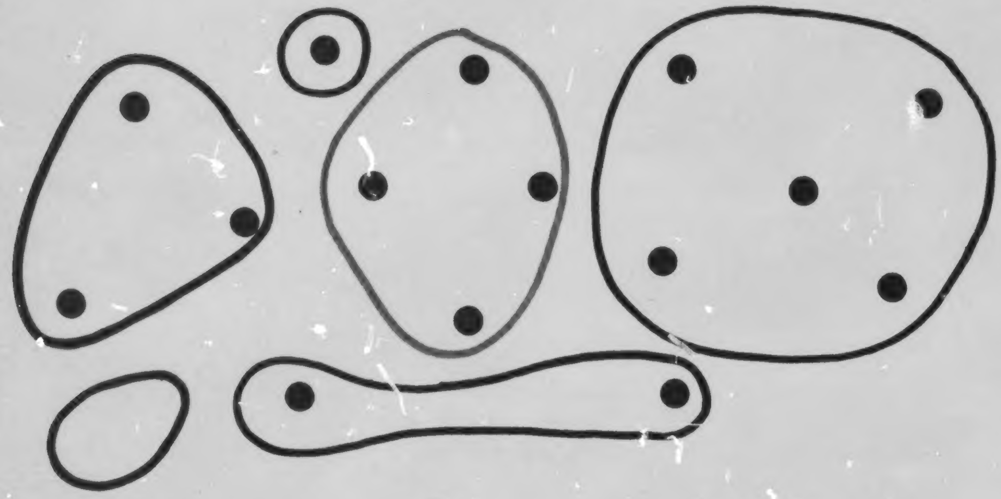
You are looking for the answer "two" but any number larger than two should be accepted as a correct answer even though only two children are needed.

Ask two children to come up to the front of the class and show 15 fingers.

Ask someone to point to " 15 " in the Numeral Row.

T: Close your eyes.

While the children's eyes are shut, complete your picture on the board by drawing these six strings[*]:



---

[*] Use six different colors.

T: You can open your eyes now. I have put all the animals who live in the same cage in the same string.

Ask various questions about your completed drawing. For example:

T: In one cage there are exactly two lions. Someone come to the board and point to these two lions. (They are in the blue string.) Who would like to point to "2" in the Numeral Row? Everybody show me two fingers. Who wants to write a "2" on the board?

The elephants - and no other animals - are in the yellow string. How many elephants are there? (Four) Who would like to point to "4" in the Numeral Row?

There are exactly three tigers in this zoo. They are all in the same cage and, of course, no other animals live in that cage with them! Can you see the three tigers? (They are in the green string.)

Is there a string that has five animals[*] in it? (Yes, the red one.)

Is there a string that has six animals in it? (No)

Are there two cages that have the same number of animals in them? (No)

Show me the string that has the most animals in it. (The red one.) How many animals are in this string? (Five) Tap five times on your desk.

---

[*] If your students want to know what kind of animals these are, tell them they are seals.

K15

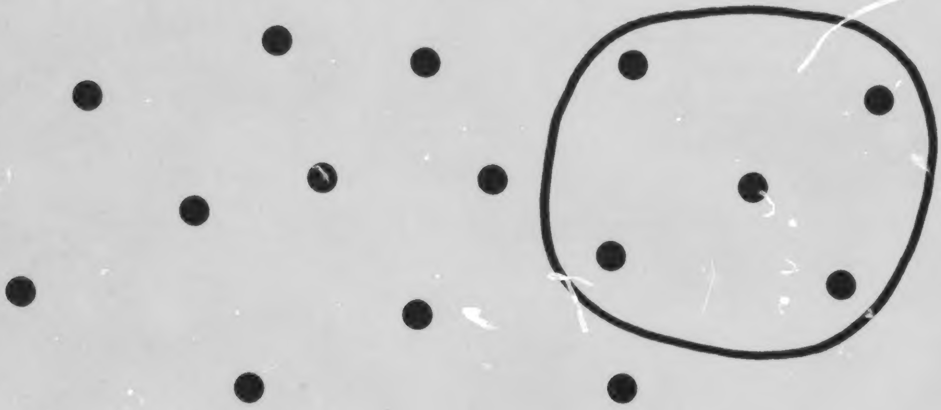
Show me the bear. He lives all by himself.

- What can you say about the purple string? (That cage is empty; there are no animals in it.)

Continue with the story as follows:

T: This is a rather special zoo. In the evening the zookeeper opens the cages and lets the animals run free in the park. Of course, the seals (point to the dots in the red string) prefer to stay in their cage so that they can be near their pool, but all the other animals love to be out of their cages so that they can run and jump all over the park.

As you say these words, erase all the strings but the red one.



T: How many animals are out of their cages? (Ten) How many animals prefer to stay in their cage? (Five) How many animals are there altogether? (15)

Write the following equation on the board:

$$10 + 5 = 15$$

Read this out loud: "Ten plus five equals fifteen."

Pair off the children. Ask one member of each pair to show ten fingers (for the ten animals which are outside their cages). Then ask the other member of each pair to show five fingers (for the five animals inside the red string).

Finally, ask each pair to show 15 fingers between the two of them.

OPTIONAL CONTINUATION OF LESSON:

Distribute copies of Worksheet K15-I.

T: What number is written in red? (4)

That tells you that exactly four animals live together in one cage. Draw four dots in the red string.

Tell the children to proceed in a similar fashion for each of the other three strings. Encourage them to draw well filled-in dots, not just circles. When a pupil has completed Worksheet K15-I successfully, he or she should be given Worksheet K15-II.

IMPORTANT NOTE:

Throughout the CSMP Kindergarten Program, the identifying number on a worksheet is generally followed by one, two or three stars. These are intended to indicate the level of difficulty of that worksheet according to the following scheme:

* - easy; everyone should be able to tackle this worksheet.

** - average; this worksheet is appropriate for about two-thirds of your children.

*** - challenging; this worksheet is appropriate for about one-third of your children.

Do not expect all your children to complete all levels of worksheets provided with a given lesson. Some children should never even see the more difficult worksheets.

No worksheets appear in this guide. They are packaged separately as tablets, each tablet containing one copy of all the worksheets required for the program.

TITLE: The Train

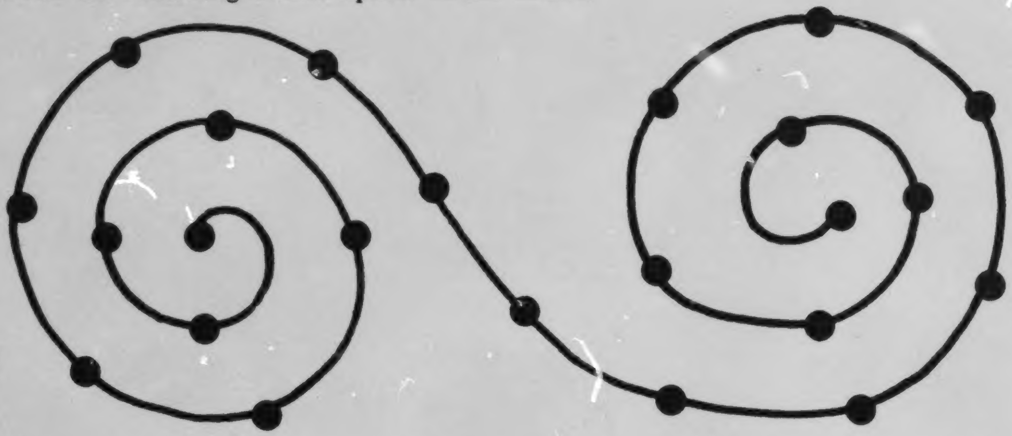
MATERIALS:

Teacher - Colored chalk*; 0-99 Numeral Chart

Students - None

DESCRIPTION OF LESSON:

Draw the following double spiral on the board:



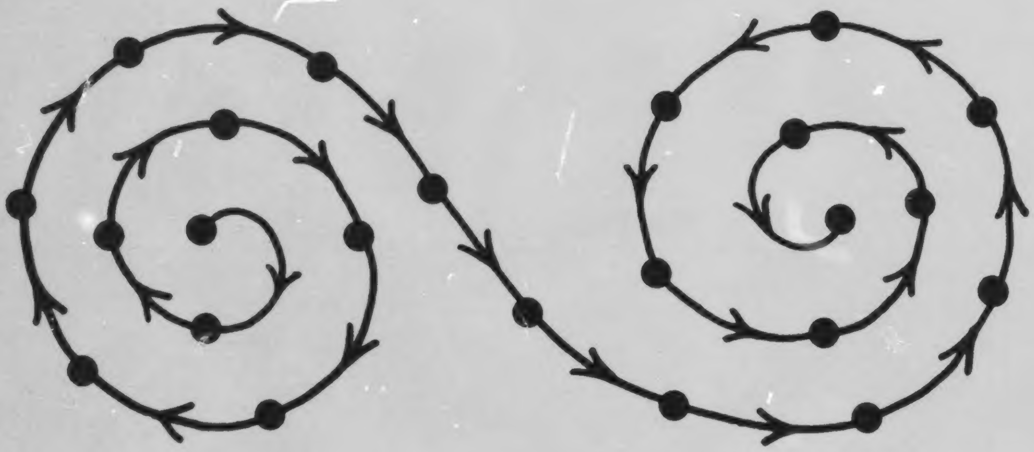
Make the spirals as large and as symmetrical as you can. Do not draw any arrowheads for the moment. There should be two fewer dots than you have children in your class.

T: This is a train. The dots are for the cars of the train.
How many cars are there?

Let several children come to the board and count the dots. Conclude that there are 23 dots. (Of course, this number will depend on how many children are in your class.)

Ask someone to point to "23" in the 0-99 Numeral Chart.

Now, add the arrowheads, as follows:



T: The arrows tell you in which direction my train is traveling.

Can anyone point to the engine? (It is the first dot on the right.)

Can anyone point to the caboose? (The last dot on the left.)

Ask various children to locate some of the cars of the train for you. For example:

T: Point to the first three cars.

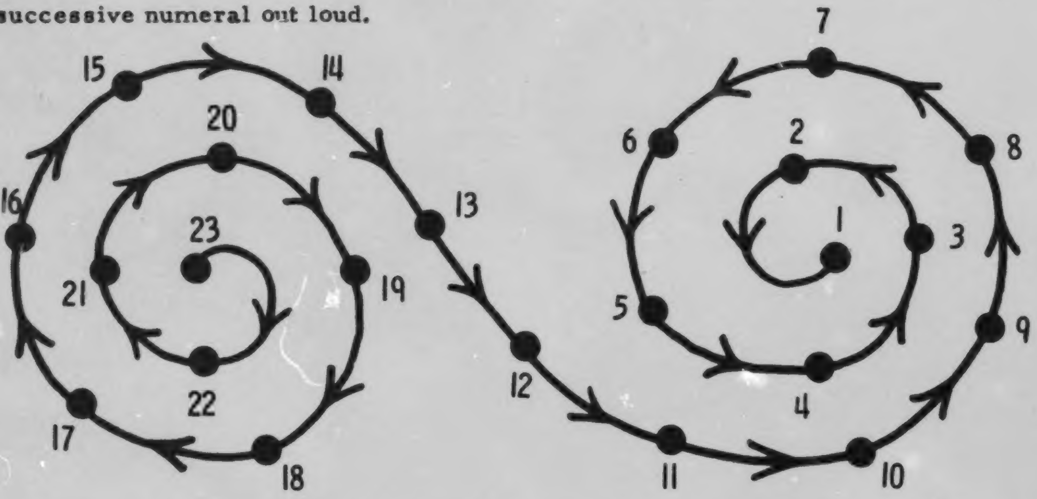
Point to the last five cars.

Point to four cars somewhere in the middle of the train.

Continue with the lesson as follows:

T: Now, I'm going to number each car. The engine is number one; then comes number two; and so on.

While you are numbering the dots, ask one child to point to the numerals in the 0-99 Numeral Chart as you reach them, and ask everyone to read each successive numeral out loud.



If your pupils enjoy reading numerals, here are two more activities for them.

A. Counting Backward

T: Let's read these numerals again, but this time we'll start with the caboose. (Point to the dots one by one as the class reads the numerals.)

B. Counting by Twos

T: Now just read the numerals I point to. (Point to "1," "3," "5," "7," and so on.) What did we do?

S: We skipped one every time.

End the lesson by letting the children act out the situation. Choose a child to be the engine, a child to be the caboose and let the others be the cars in between. Remind the "engine" not to move too fast. When your "live train" has walked around the room a little, say:

T: I am the stationmaster and I want to know how many cars are in this train. Let's count them as they pass in front of me.

Once all the "cars" have been counted, ask the children to stop the train game.

T: How many cars are there in our train? (25[*]) How many cars were there in the train I drew on the board? (23)
Which one has more cars?

S: Our train.

T: Right. How many more?

S: Two.

---

[*] Of course, this answer will depend on how many children you have in your class.

TITLE: K - A Blocks #3

Activity 1: Find It.

MATERIALS:

Teacher - None

Students - One set of K - A blocks per child (see the note in Lesson K8)

DESCRIPTION OF ACTIVITY:

The rule of this activity is simple. You ask your children for certain of the K - A blocks. If they have that piece, they should hold it up.

It is very easy to vary the level of difficulty of this exercise. Be careful that you select sufficiently challenging questions, and that you proceed at a brisk pace. The following are examples of things you might ask. They are grouped according to their level of difficulty.

Easy:

T: Show me a red piece; a different one; another different one
a triangle; a different one; another different one
a blue square; a different one; another different one
a piece with four sides; a different one; another different one
two green circles.

Intermediate:

T: Show me a piece that is not red; a different one; another different one a piece that is not a circle; a different one; another different one

a square that is not yellow; a different one; another different one

two circles of the same color

two triangles of different colors

a green circle and a red square.

Difficult:

T: Show me a piece that is red and not blue; a different one

a piece that is not a circle and not red; a different one

a piece that is both red and blue (there is no such piece).

Find all the red pieces with four sides. Do they all look alike?

Activity 2: The Hidden Piece.

MATERIALS:

Teacher - One set of K - A blocks (see the note in Lesson K8); a towel*

Students - None

DESCRIPTION OF ACTIVITY:

Display some of the K - A blocks on the chalk tray or on a table, and make sure that each child has a chance to see exactly which pieces are there. Then cover the pieces with a towel, move them around under the towel, and then remove one of them in such a way that no one sees which piece you have removed. Uncover the remaining pieces. The students have to say which piece is missing.

The first game should be a simple one with, for example, a small red circle, a large yellow triangle, and small blue square.

In later games, the complexity of the initial array of pieces can gradually be increased. For example, here is a more difficult situation: Start out with a small red circle, large red circle, small red square, small green triangle. Remove one of the circles.

You should insist on precise identification of the missing piece (i. e., its color, shape and size), especially in situations such as the last one.

Each time you use this activity, play the game several times in a row.

K18-1

TITLE: Orchestra

MATERIALS:

Teacher - Colored chalk

Students - None

Optional:

Instead of the children's tapping on their desks you could provide some ordinary percussion instruments (such as tambourines), or let them tap on cans, boxes, etc.

DESCRIPTION OF LESSON:

Spend 10-15 minutes doing as many of the following activities as you think desirable.

Activity 1:

Ask your students to tap twice on their desks (or on the floor), clap their hands twice, tap twice on their desks, and so on .... If necessary, demonstrate what you mean by doing it yourself. Give a clear signal to indicate when they are to start.

Record this pattern on the board, explaining that you are going to use red for "tap on your desk (or the floor)" and blue for "clap your hands."

● ● ● ● ● ● ● ● ● ● ...

T: If I continue the pattern, what do you think will come next?

S: Two blues.

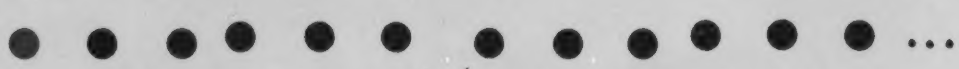
T: And then?

S: Two reds.

Ask the students to tap and clap again and this time you should point to the appropriate dots as they are doing so.

Activity 2:

Draw the following pattern on the board:



T: What do the red dots mean?

S: Tap on your desk (or the floor).

T: And the blue dots?

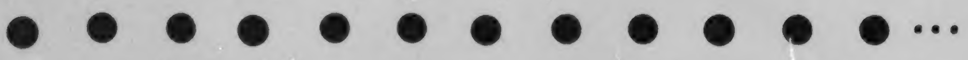
S: Clap your hands.

T: Look carefully at the pattern I have drawn.
Who can do what it says?

Let volunteers make attempts at doing this. As soon as someone manages to do it correctly, let the whole class join in. Once again, give a very clear signal to indicate when they are to begin.

Activity 3:

Draw the following pattern on the board:

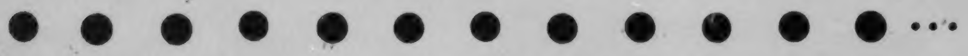


T: Look at this drawing very carefully. Who would like to try to do what it says?

As soon as someone manages to do this correctly, let the whole class join in.

Activity 4:

If your class enjoys this activity, let them try this pattern:



It might be interesting to ask the class to compare the last two patterns.

IMPORTANT NOTE:

It is suggested that Lesson K18-2 be taught on the same day as Lesson K18-1. There is a question in Section One of this guide whose answer provides more information on this point.

TITLE: Everyone Listens, Everyone Acts

MATERIALS:

Teacher - None

Students - None

DESCRIPTION OF LESSON:

Spend 5-10 minutes on this activity.

The purpose of this game is to get the students to listen, and then to carry out a series of directions.

Before starting the game, create the atmosphere:

T: Now I want the room so quiet that I could hear a pin drop. Everyone open his ears and listen hard. We are going to play a "good listener's game." Don't do anything before I stop talking. Ready?

Then give a sequence of instructions such as the following. (Notice that each instruction contains one more command than the previous instruction.) After each instruction the children should be allowed sufficient time to perform the commands.

Instruction 1: Stand up, clap your hands.

After they have carried out this instruction, ask everyone to sit down again.

Instruction 2: Stand up, take one step forward, sit down again.

Instruction 3: Stand up, clap your hands, jump two times on the spot, turn to the left.

Vary these instructions as much as you can so as to maximize the children's enjoyment of the game. It is difficult to concentrate when one's ears are bombarded with a large number of words, so keep your instructions precise and to the point.

This game could be made more challenging by stipulating that students who make a mistake in carrying out the instructions are "out." However such a rule is likely to eliminate the very children who need the activity the most. Therefore, you should only use this "exclusion" rule once in a while, not all the time.

IMPORTANT NOTE:

More exercises in listening are provided in Section Four of this guide.

EARLY WARNING:

Lesson K19 calls for a small doll such as a little robot or toy policeman or fireman.

113

TITLE: Robot Walk #1

MATERIALS:

Teacher - A copy of the Robot Walk Grid; colored checker (you could use a demonstration Minicomputer checker); a small doll* (a robot or a fireman or a policeman, etc.)

Students - None

IMPORTANT NOTE:

The Robot Walk Grid is called for in several lessons in the Kindergarten program. In some lessons (such as this one) nothing is written on the copy of the grid that you use, and so that copy will be reusable. In other lessons (such as K27), if you use a copy of the grid it will not be reusable. Hence you should do your best to make maximum use of the number of copies of the grid with which you have been provided.

DESCRIPTION OF LESSON:

Organize your classroom in the following way:

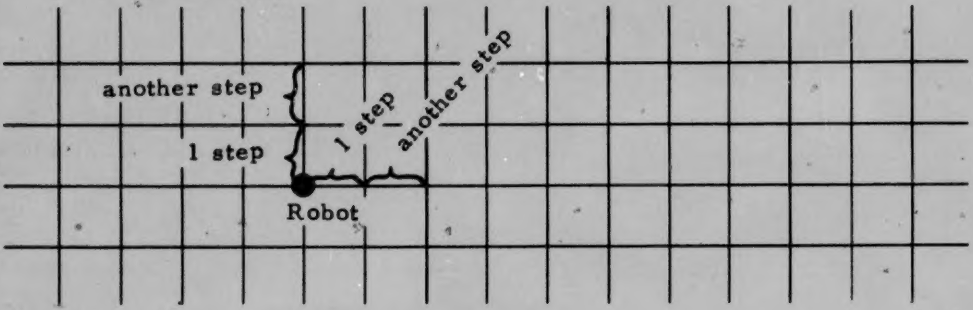
- Attach the Robot Walk Grid on top of a table.
- Ask all the children to stand in a circle around the table, but about a meter away from it so that everyone can see, and yet no one is tempted to lean on the table, play with the "robot," and so on ...

You may want to reinforce this idea by drawing a circle on the floor and explaining that no one except robots and robot operators are allowed inside that circle.

It is very important to explain the rules clearly. They are the following:

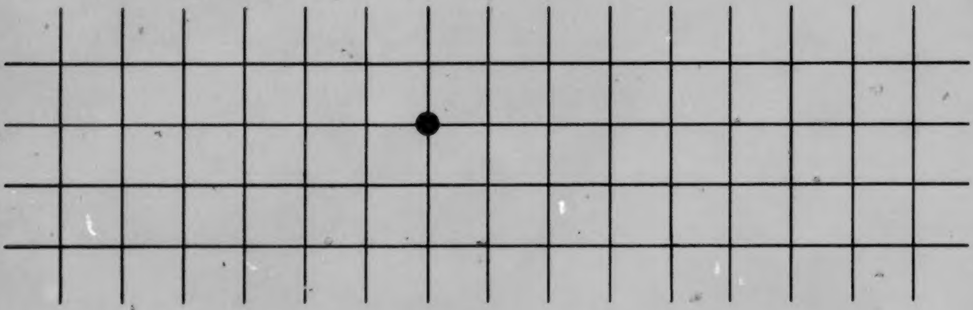
- The little doll is a robot. He always obeys any simple directions that are given to him. But he always does exactly what you tell him, so you have to be careful what you say.
- The robot can only move along the black lines.
- The robot moves along the black lines by taking steps. One step consists of a move from one intersection to the next in any of the four possible directions.

Demonstrate what you mean by this last rule as follows:



Activity 1:

Place the robot on an intersection.



Choose one child to be the robot operator. Give directions to the operator yourself, one at a time.

Phrase your directions like this:

Forward two steps
Turn to the window[**]
Back one step
Turn to the chalkboard[**]
Forward five steps

and so on.

Activity 2:

Proceed as in Activity 1 with one child being the robot operator, but this time let another child give the directions (still one at a time).

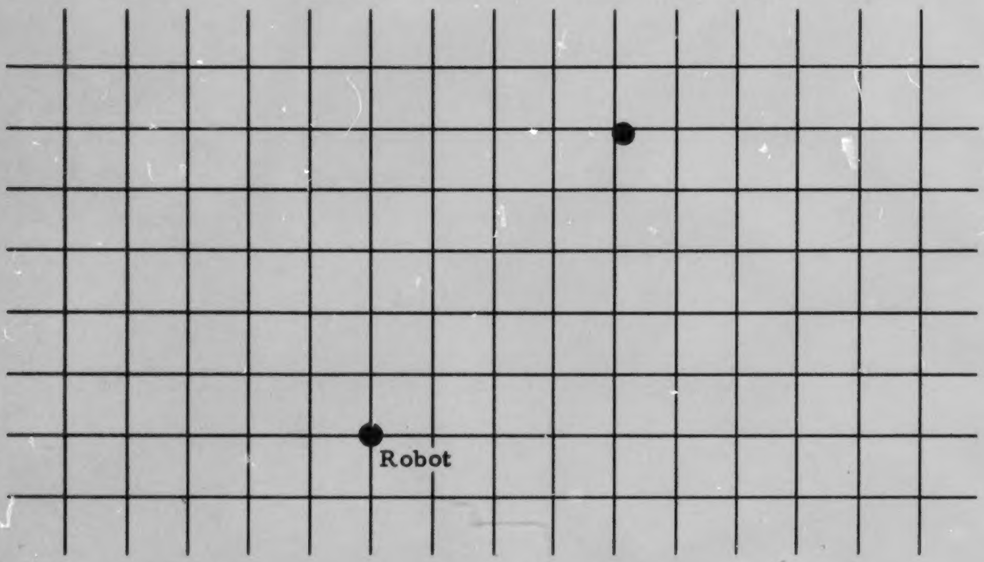
A direction which, if obeyed, would send the robot off the portion of the grid that you have displayed is illegal. When a child gives such a direction:

- the whole class should be encouraged to protest (by raising both hands, for example)
- the robot ignores it, and
- the child who gave the direction has to relinquish that responsibility in favor of another child.

[**] Even if your students know which is their right hand and which is their left, asking the robot to turn to its right is altogether a different problem. We will deal with commands such as "turn to the right" in a later lesson. Do not introduce them now.

Activity 3:

Place the robot on one intersection and a colored checker on another.



Once again, one child is the robot operator while another child gives directions (still one at a time). The goal is to give a sequence of directions so that the robot eventually reaches the colored checker (not necessarily by the shortest route).

Since there are many routes by which the robot may reach the checker, you could ask two other children to find a second route.

TITLE: Centimeter Rods #4 (Staircase)

MATERIALS:

Teacher - Demonstration C-rods (see the note below), masking tape*; (optional) 0-99 Numeral Chart

Students - A set of centimeter rods* per one, two or three children

IMPORTANT NOTE:

The demonstration C-rods provided by CSMP are "blown-up" copies of the rods made by the Cuisenaire Company of America. If your children are using rods made by a different manufacturer, you will need to make your own "blown-up rods" whose colors correspond with the rods in the children's sets.

DESCRIPTION OF LESSON:

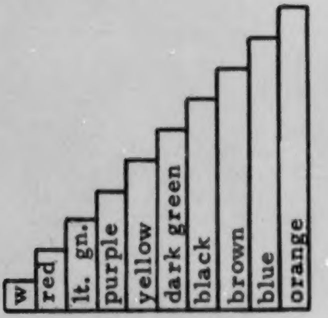
Allow the children to play freely with the rods for about five minutes.

Then ask them to pick out the shortest rod and to name it by color. (The white one)

Next ask for a rod that is just a little bit longer than the white one. (The red one)

Ask for a rod that is just a little bit longer than the red one. (The light green one)

As the children name each rod, attach the corresponding demonstration C-rod to the chalkboard using masking tape. In this way you will construct a staircase and the children should be invited to do the same thing with their rods at their desks.



When all the staircases have been built, say:

T: Let's pretend a little mouse is climbing the stairs, counting as he goes: One, two, three, ..., ten. (Point to the rods, one after another, as you count.)

You may wish to repeat this procedure two or three times until everyone is counting in unison.

T: Now our mouse is at the top of the staircase. Let's get him back down to the bottom of the stairs again. We will have to count backward. (Place your finger on the top step.) Ready? Ten, nine, ..., two, one.

Again, this will probably need to be repeated once or twice.

T: Now the mouse is at the bottom of the staircase again. Let's get him to climb up to the top and come right back down again. (Place your finger on the bottom step.) Ready? One, two, ..., nine, ten, nine, ... , one.

T: Let's do that once more, but this time we will pretend that the staircase goes up and up and up, and we will count as far as we can before coming back down again.

Let the children count forward as far as they can, and then backward from there. It might help if one child points to the corresponding numerals in the 0-99 Numeral Chart one by one while the others are counting.

K21-1

TITLE: Transforming a Number #1

MATERIALS:

Teacher - A magnetic board* (see the note at the beginning of Lesson K6); demonstration Minicomputer checkers

Students - None

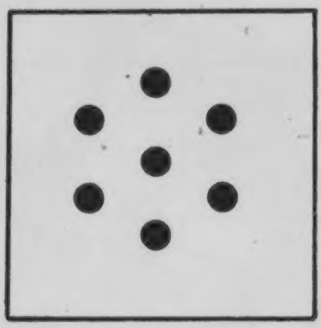
IMPORTANT NOTE:

You may change the number you work with in this lesson according to the numerical ability of your pupils.

DESCRIPTION OF LESSON:

Spend about 10-15 minutes on this activity.

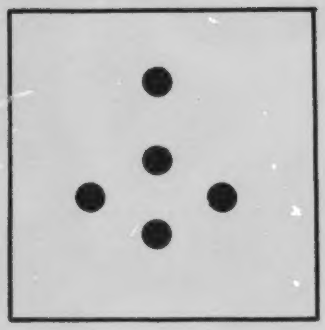
Display seven checkers on the magnetic board as follows:



T: These are birds and they are flying around. How many of them are there?

S: Seven.

Very obviously remove two checkers:



T: Are there still seven?

S: No.

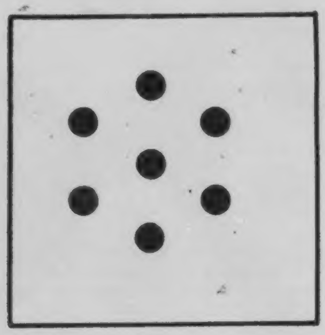
T: Are there more than seven or fewer than seven?

S: Fewer than seven.

T: How many fewer?

S: Two.

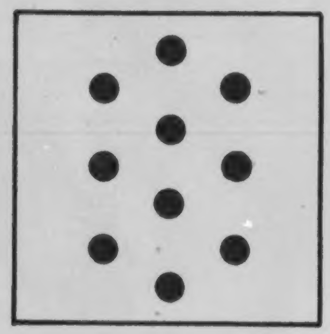
Put the two checkers back.



T: How many now?

S: Seven.

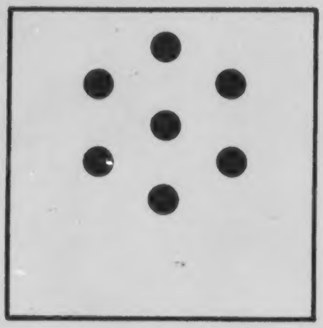
Very obviously add three checkers of a different color.



T: Are there still seven?

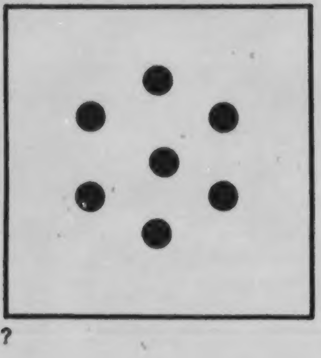
S: No. More than seven.

Make it seven again by removing the three checkers you added.



T: Here are the seven birds again.

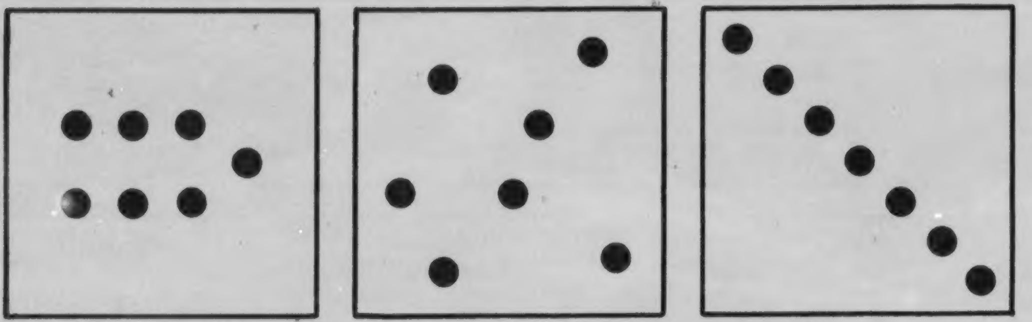
Replace (again, very obviously) a red checker by one of a different color.



T: Are there still seven?

S: Yes. You just changed colors.

Make all seven checkers the same color again, then move them around, without adding or removing any (you must be obvious about this).



Each time, ask if there are still seven birds there.

Alternate examples where you change the number with examples where you don't change the number. After each move, go back to the original seven checkers.

You could make this into a little game by asking the children to raise their hands if they think it is still seven, and to put their hands under the table if they think it is no longer seven.

K21-2

TITLE: Write and Draw

MATERIALS:

Teacher - Paper*; colored pens, * pencils* or crayons* (red and blue)

Students - Paper*; red pen, pencil or crayon*; blue pen, pencil or crayon*

DESCRIPTION OF LESSON:

Spend about 5-10 minutes on this activity.

Ask everyone to show four fingers.

Let a student point to "4" in the Numeral Row while everyone else traces a "4" either on his or her desk or in the air.

T: On your paper, draw four red dots and four blue dots.

Now write a beautiful red "4," and a beautiful blue "4."

NOTES:

1. This short numeral-writing activity could be repeated at various times throughout the year using other numerals.
2. If any of your children are having particular difficulty with writing numerals, you are referred to Section Four of this guide which includes a collection of ideas about how you might help.

K22

TITLE: Children and Houses

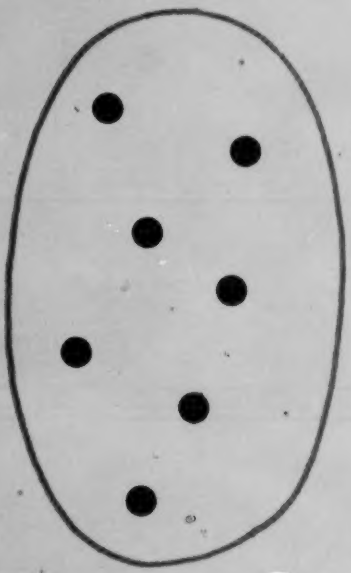
MATERIALS:

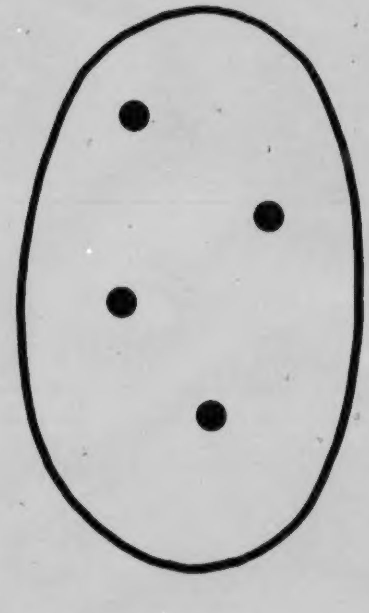
Teacher - Colored chalk*

Students - None

DESCRIPTION OF LESSON:

Draw the following on the board:





T: In the yellow string there are some children.

In the red string there are some houses.

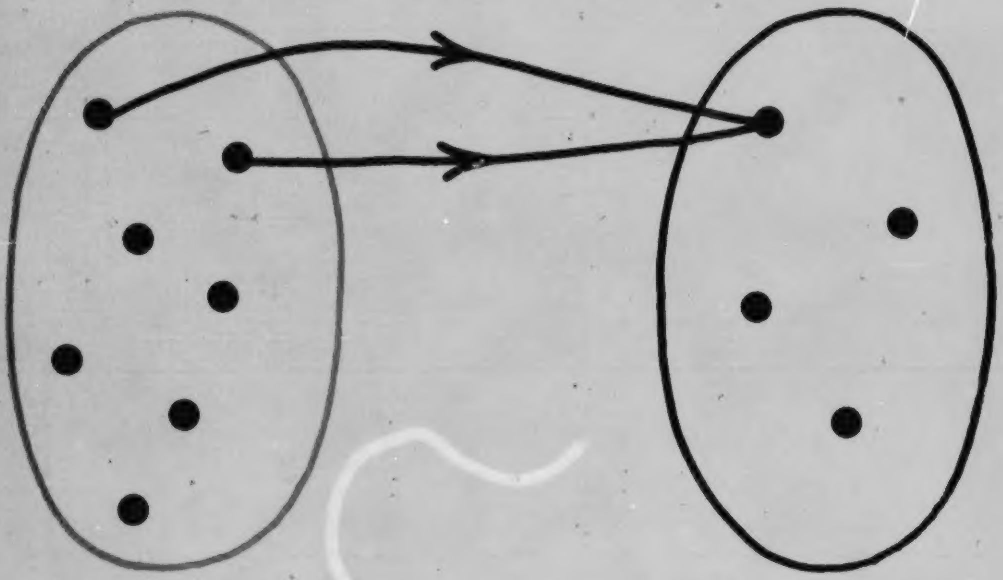
How many children are there? (Seven)

How many houses are there? (Four)

Let the students count the dots, show the numbers with their fingers, show the numerals in the Numeral Row, and write the numerals on a piece of paper.

K22

Draw the following two blue arrows:

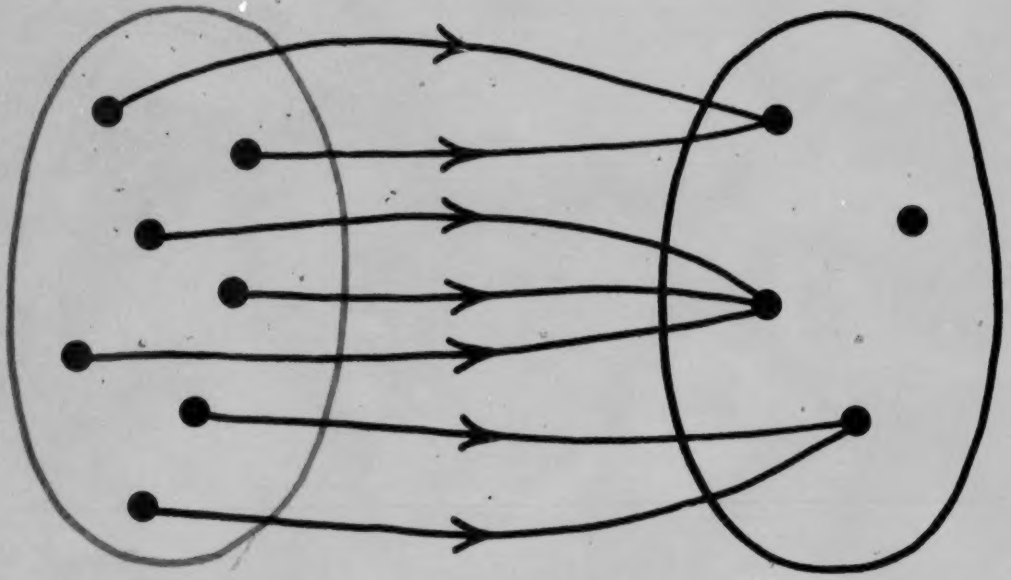


As you are doing this, say:

T: **This child lives in this house; and this child lives in the same house. They are the only ones of these seven children who live in this house. How many of these children live in this first house?**

S: **Two.**

Complete your drawing on the board one house at a time:



Point to a dot in the yellow string.

T: Who can come here and point to the house in which this child lives?

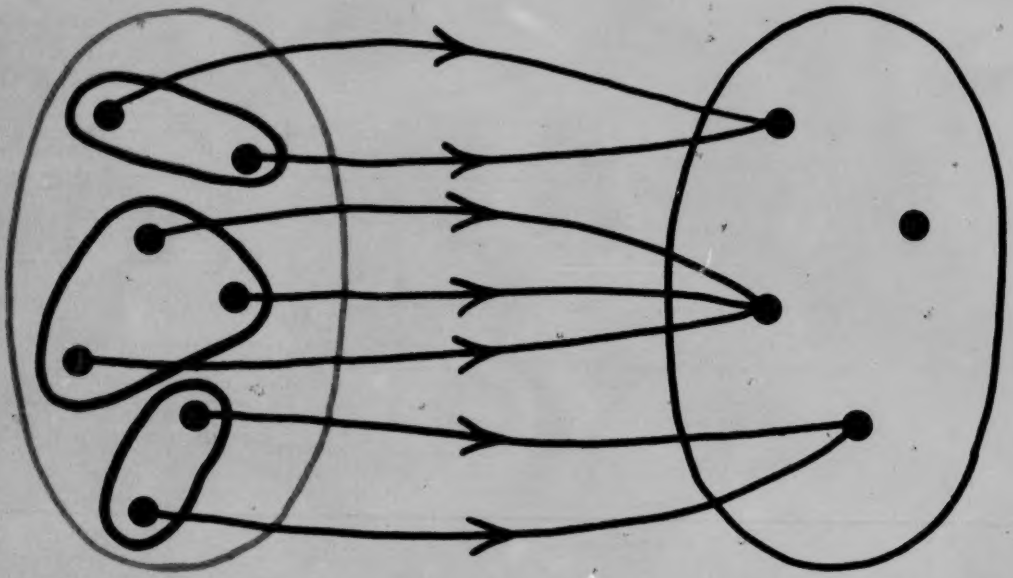
Repeat this for other dots in the yellow string if you wish.

Next point to a dot in the red string.

T: Who can come here and show us which children live in this house?

When a student has correctly indicated all the children who live in the house in question, ask him or her to trace a string around these children. Draw the string in yourself.

Repeat this question for each house that is occupied by some of these seven children.



T: Does each of these seven children live in one of these four houses? (Yes)

Does each of these four houses have some of these seven children living in it? (No)

Which house has the largest number of these children living in it? (The one with three children.)

Which house has the smallest number of these children living in it? (The one with no children.)

Are there some houses which have the same number of these children living in them? (Yes. The two houses which both have two children living in them.)

TITLE: "The Playful Numbers"

MATERIALS:

Teacher	-	One copy of the storybook, "The Playful Numbers"
Students	-	One copy of the storybook, "The Playful Numbers," for each pair of students

DESCRIPTION OF LESSON:

"The Playful Numbers" is a delightful little story that contains no words. It is deliberately presented in this way in order that this early experience with numbers will be open-ended. Numbers can be viewed from an infinite number of angles; and if children are permitted to explore these possibilities, rather than having arbitrarily fixed boundaries laid down for "what numbers are," their mathematical lives will be so much richer.

We encourage you to be an active participant with your students in the exploration of this little book. Ask them to help you create a story about the boy, his number friends and his other friends. You may very well be surprised and delighted to discover some new ways of thinking about numbers!

The situations pictured in this book might give the appearance of being quite independent from each other, the only link being the quasi-magical effect these playful numbers have on the environment. But, if you take a second look at the pictures you will notice that there are a few details here and there that provide additional links between them.

For instance,

Three red buttons drop onto the floor on pages 2-3. On pages 12-13, the same three buttons show up again along with six blue ones.

In the picture on pages 10-11, five of the cats are each holding a white flag. But, wait a minute ... so were the five mice on page 7. Whatever could have happened?

Because of the role played by details such as these, it is important for the children to be able to see the pictures very clearly. Therefore, you might want to gather your students close to you and to hold up your copy of the book to show them the pictures.

We suggest that, for this particular book, you do not distribute copies of the book to your students right at the beginning of the lesson. Experience has shown this to be more distracting than useful.

When you and your students have finished "reading" the story, don't rush the children into another activity. Instead, give a copy of the storybook to each pair of children and let them look at the pictures at their own pace. Make them feel free to talk about the book (with you or with their partner).

Your children would enjoy it greatly if they were able to have a copy of the storybook to keep. This can be arranged if your school is prepared to buy sufficient additional copies of the book so that you have one copy for each child. However, if it is not the intention of your school to purchase a new set of storybooks each year, once your children have had ample opportunity to look through the book, collect them in so that they can be reused next year.

In any case, you should leave at least one copy of this storybook permanently available in the classroom for children who wish to glance through it in their spare time.

EARLY WARNING:

Lesson K24 calls for a full-length mirror.

TITLE: Mirror Symmetry #1

MATERIALS:

Teacher - A full-length mirror*

Students - None

DESCRIPTION OF LESSON:

Activity 1:

Choose one child to stand in front of the mirror and position the others so that they can see at least part of the image in the mirror.

Ask whether anyone knows what the "other" child in the mirror is called. (Image or Reflection) If no one knows, introduce the word "image" yourself.

Now ask the child to move his arm that is nearest the chalkboard (or nearest the windows, or the flagpole. The words "left" and "right" should be avoided here.)

T: What does the image do? (It also raises the arm that is nearest the chalkboard.)

Then try other motions, each time using as reference points objects that are to the right or to the left of the child.

T: Move your head toward the door. What does the image do?

Let the class express their observations and discuss them.

At some point, you should also give instructions such as the following:

T: Take one step toward the mirror. What does the image do? (It comes closer .... It moves forward.)

T: Now step backward, away from the mirror. What does the image do?

Activity 2: The Mirror Game.

This activity should follow immediately after the one above. Ask the children to face each other in pairs. One child in each pair is to act as the "person," the other is to act as the "image." (If the first child raises his right arm, the "image" must raise his left arm. Again, avoid the use of the terms "left" and "right" in this activity.)

The "persons" should be free to make whatever movement they like.

After a while, let the children switch roles so that everyone gets a chance to be an "image."

If any "images" appear to be confused, take them one at a time up to the mirror, ask them to move an arm or a leg, and let them observe what the image does. Then let them return to their partners.

K25

TITLE: K - A Blocks #4 (Guess My Rule)

MATERIALS:

Teacher - A set of K - A blocks (see the note in Lesson K8)

Students - None

DESCRIPTION OF LESSON:

Lay out a short sequence of K - A blocks so that all the students can see them. The pieces can be put on the chalk tray, on the floor, on top of a table, or wherever you wish. You should have some simple rule which you have used to generate the sequence. For example, your rule might be: red, blue, red, blue, and so on. Or if you use only the pieces which come in two sizes, your rule might be large shape A, small shape A, large shape B, small shape B, etc.

After you have displayed four or five pieces (enough to give a clear illustration of your rule), ask the students to try to guess your rule. Any student who claims to know the rule should be allowed to place the next piece. If this is done correctly, you should praise him or her and ask that the rule be kept a secret. If the student guesses incorrectly, you should say:

T: No, that's not the rule _I_ was thinking of.

and remove the incorrectly placed piece.

It is important to realize that there are no wrong answers in this activity; a student could very well have a valid rule in mind that is different from yours.

Hence, you should be careful to avoid saying, "You are wrong."

After several students have been able to place successive pieces correctly, you should ask someone to state the rule. Of course, it is possible to place a piece correctly while not knowing the rule, so you should see that several pieces have been placed correctly before asking for the statement of the rule. Then ask some children to "read" the whole sequence of shapes for you.

The game can be made more difficult by increasing the complexity of the rule. Some possible rules are given below. Choose the ones that seem more appropriate to your students.

1. Red, red, red, and so on. (All one color.)
2. Square, square, square, and so on. (All one shape.)
3. Red, green, green; red, green, green; red, green, green; and so on.
4. Circle, circle, ellipse; circle, circle, ellipse; circle, circle, ellipse; and so on.
5. Circle, triangle, square; circle, triangle, square; circle, triangle, square; and so on.
6. Red circle, green square; red circle, green square; and so on.
7. Red circle, blue triangle, red circle, yellow square; red circle, blue triangle, red circle, yellow square; and so on.

K25

Since this game is going to be used again in Lesson K88, it might be a good idea to make a note on your copy of the present lesson of which rules you used this time.

EARLY WARNING:

Lesson K26 calls for a very large sheet of paper (for instance, a length cut from a roll of wallpaper); sufficient small paper rectangles cut out of colored paper so that each student can have several; and some glue.

TITLE: Number Collage #1

MATERIALS:

Teacher -	A very large piece of paper* (for instance, a length cut from a roll of wallpaper); glue*
Students -	Several small paper rectangles* for each child (use paper of various colors and sizes); colored crayons*, felt tip pens* or finger paint*

IMPORTANT NOTE:

In this lesson, the children are to make a collage out of numbers. If your class is familiar with collage activities, organize this activity as you usually do.

DESCRIPTION OF LESSON:

Give each child several small paper rectangles. Ask your children to write the name of a number on each piece of paper. They should be free to choose any number they like, and write its name in any color and as large or small as they like.

Then ask everyone who has written a "0" to come to the front of the class and glue the piece of paper with a "0" on it somewhere on the big sheet of paper. (If someone has written several "0's" he or she should bring them all!)

Proceed in a similar fashion for those children who have written a "1," a "2," and so on until you reach those who have written a "10."

At that time, ask the children who still have not glued all their pieces of paper onto the big sheet to show those that are remaining one by one and, after having read the number written on each piece (with help, if necessary), to glue it onto the big sheet.

EARLY WARNING:

Lesson K27 calls for a square grid. See the lesson itself for details.

TITLE: Taxi-Geometry #1

MATERIALS:

Teacher - A square grid* (see the note below); colored chalk*

Students - None

IMPORTANT NOTE:

The square grid that you use could be any one of the following:

- a commercially made grid chalkboard
- a grid that you have drawn on your regular chalkboard
- a grid that you have drawn on a very large sheet of paper
- a copy of the Robot Walk Grid (see Lesson K19).

If you have any choice in the matter, it is recommended that the grid lines be approximately 8cm apart.

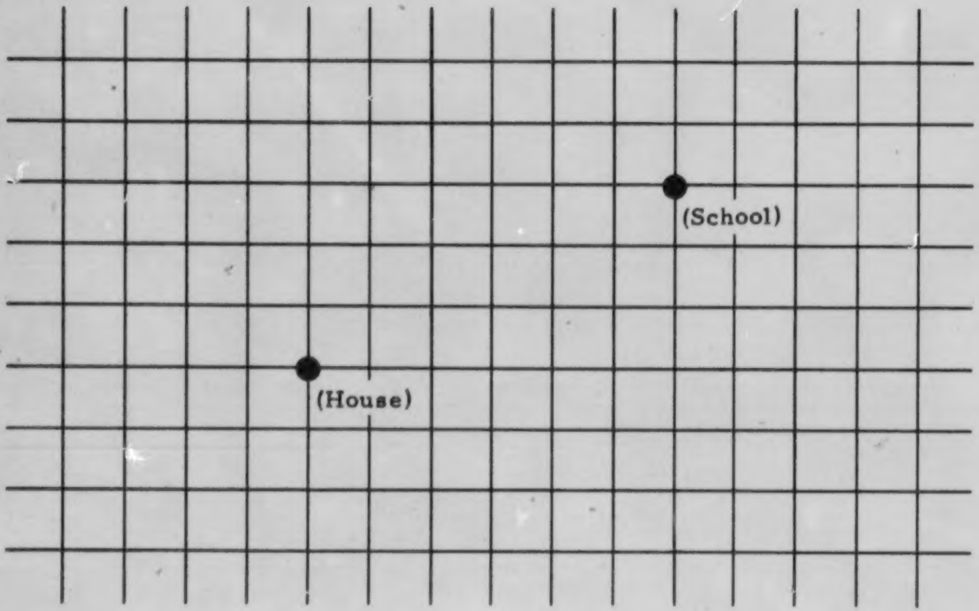
DESCRIPTION OF LESSON:

T: Today I am going to tell you a story about a little boy called "Nick." This is a map of the city where Nick lives. (Point to the square grid.) The lines are for streets.

Let some students trace along some of the streets with a pointer.

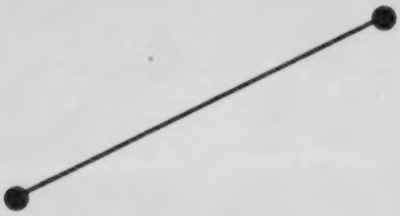
T: Here is Nick's house (draw a dot on an intersection), and here is Nick's school (draw a dot on another intersection as in the picture on the next page. Don't write the words "house" or "school.").

K27



T: Each morning Nick walks from his house to the school. And, of course, he has to follow the streets. Can you show one way Nick could go from his house to the school? (The children should indicate the possible paths using a pointer. You should draw all correct suggestions.)

If someone suggests the following:



ask,

T: If Nick went that way, would he stay on the streets?

S: No, he would be walking through people's houses and across their backyards.

T: Do you think he would be allowed to do that?

S: No. He has to follow the streets.

It is possible to find a very large number of ways to go from Nick's house to the school. Try to arrange things so that your final picture will have several different ways shown, each drawn in a different color.

If you find that your children are not very adventurous in their suggestions, you could try to stimulate them to increase the variety of the ways they indicate by saying something such as,

T: Every day Nick likes to try out a different way of going to school. He is free to walk anywhere he likes in the city. (Make a grand movement with your hand encompassing the whole of your grid.)

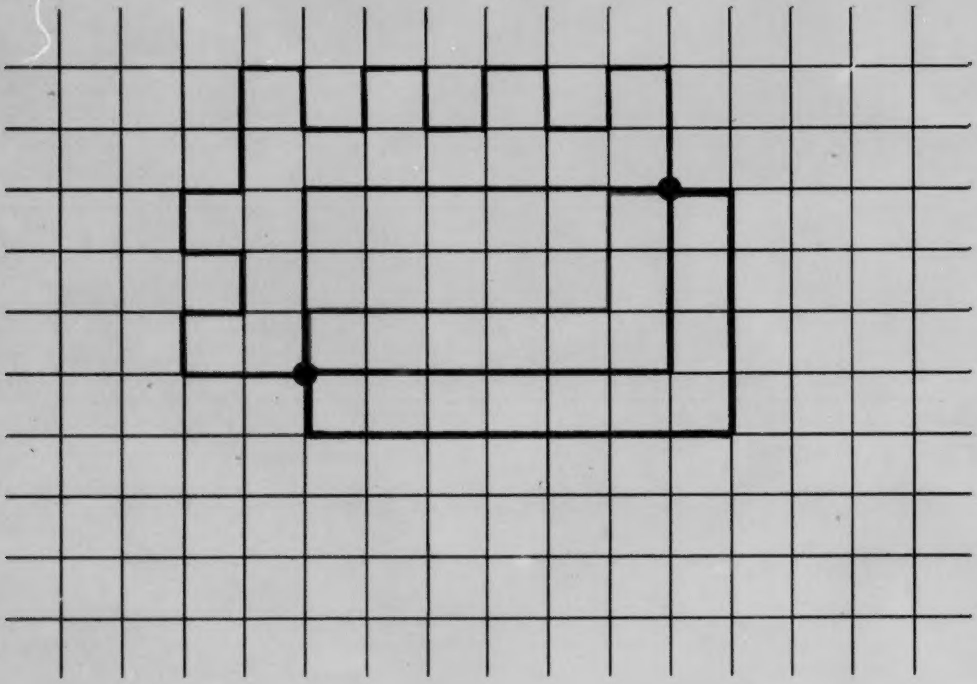
To generate long ways, make a statement such as the following:

T: One day the sun was shining brightly and Nick left for school early so that he could take a long, long walk from his house to the school.

To generate short ways, make a statement such as the following:

T: One morning Nick woke up late. He was in a big hurry. He tried to find a very short way to school.

After a while, your grid might look like the following:



FOR YOUR INFORMATION ONLY:

There are many "short-cuts" from Nick's house to the school. For instance, in the above picture the blue path, the yellow path and the green path all have exactly the same length, and there is no shorter path possible.

If your class is still interested, ask:

T: Which way do you think is the shortest?

Which way do you think is the longest?

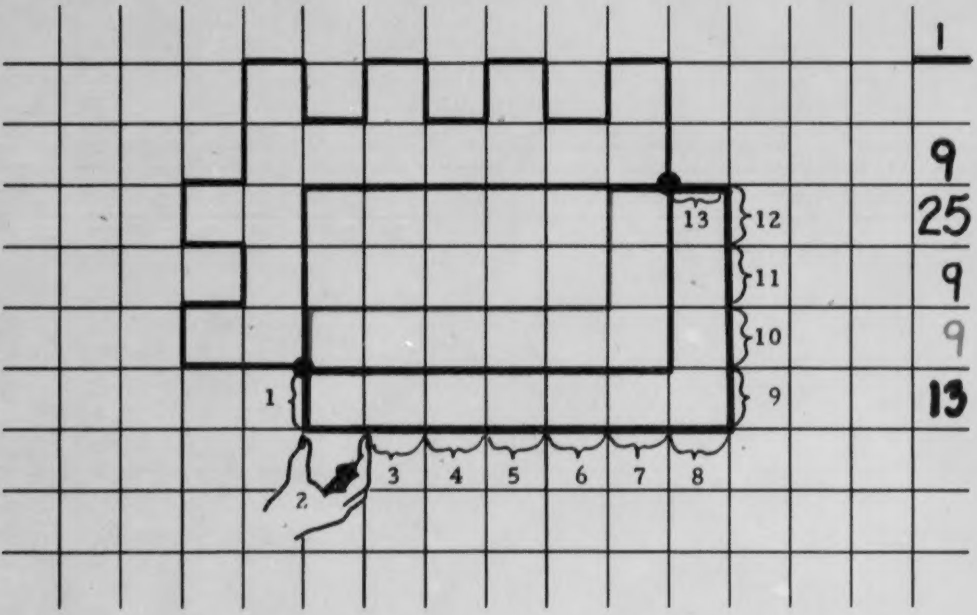
There will probably be quite a bit of disagreement about the answers to these questions.

T: Mary thinks the red path is the longest, but John thinks the black one is longer. How can we find out who's right?

If no one suggests counting how many blocks long each path is, do so yourself.

It is probably better that you indicate the blocks (use two fingers, as shown in the case of the black path below), since this is the first time your children have seen this activity.

Record the unit (one block) and the length of each path using colored chalk, as illustrated in the following diagram:



Your students will probably conclude, in our example above, that three of the ways that have been shown are "shortest," each of them measuring nine blocks.

IMPORTANT NOTE:

If your students are still finding it difficult to compare two numbers, counting how many blocks long each path is may not help them decide which is the longest. Let's suppose, for example, that they are in doubt as to whether 25 is larger than 13 or not. Here is an easy way to solve the problem: Give one student a piece of paper with "25" written on it, and another student one with "13" written on it. Tell both children to hold up their pieces of paper, and ask the rest of the class to start counting from 1. As soon as the class says a number that is written on one of the pieces of paper, the child holding that piece of paper is to put it down. The number which stays in the air the longest is the largest.

K28

TITLE: Chicks and Hens

MATERIAL:

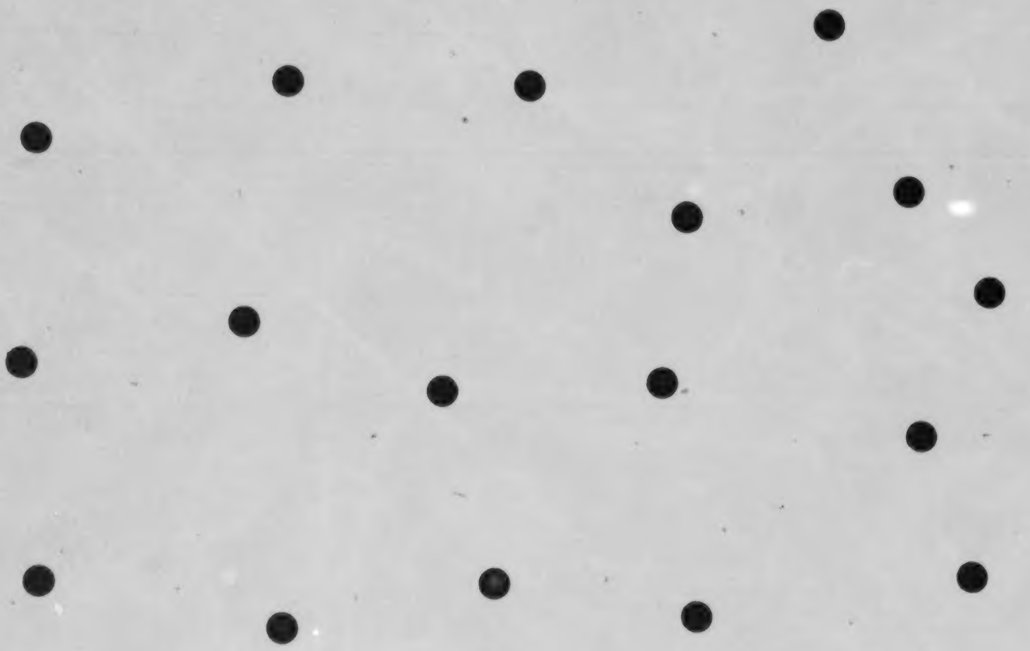
Teacher - Colored chalk*

Students - None

DESCRIPTION OF LESSON:

T: This story takes place in a farmyard where some mother hens are running around with their cuddly, little, yellow, fluffy baby chicks. Here they all are. Count them as I draw.

Draw 17 dots as follows, spread out across your entire board:



T: How many altogether? (17)

Ask a child to count the dots again, out loud, and to point to "17" in the Numeral Row.

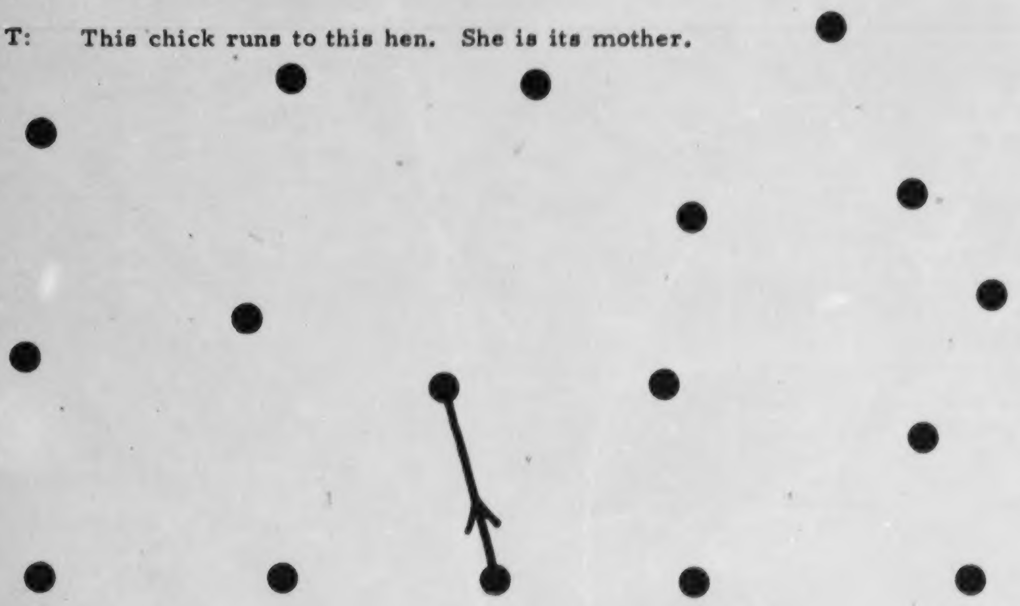
T: 17 dots. What are they for?

S: Chickens.

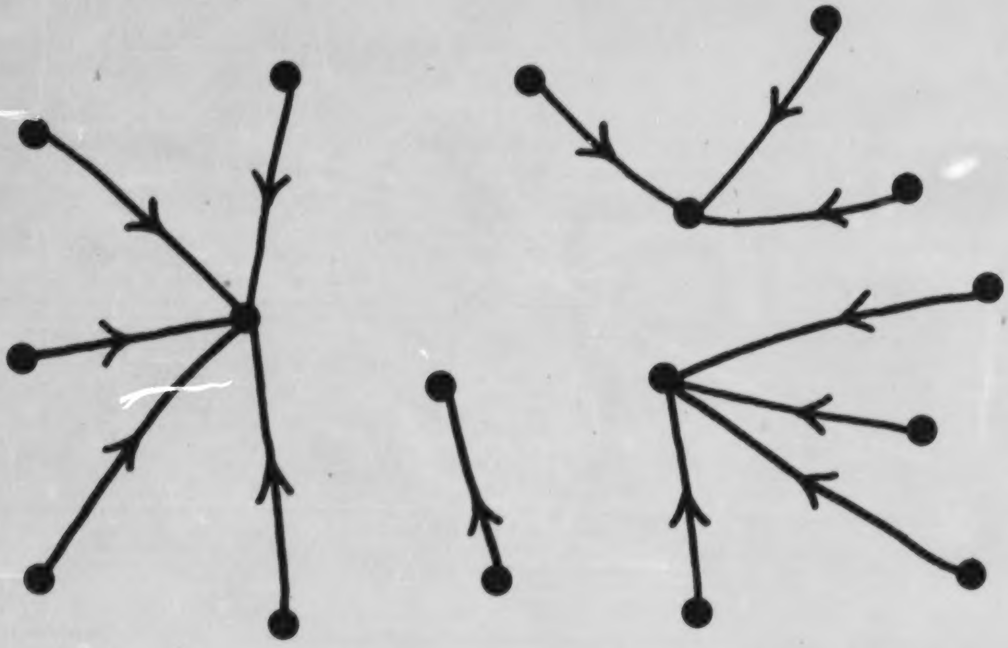
T: Right. Some are baby chicks, some are mother hens. We don't know which is which for the moment.
Suddenly there is a thunderstorm with lots of lightning, thunder, and heavy rain. The baby chicks are frightened, so each one runs to its mother.

Draw one arrow, and, as you do so, say:

T: This chick runs to this hen. She is its mother.



Ask a child to point to the baby chick and to the mother hen. Then ask your students to close their eyes while you complete your drawing.



At this point there are several problems you can pose. For example,

T: Point to a baby chick.

Point to a mother hen.

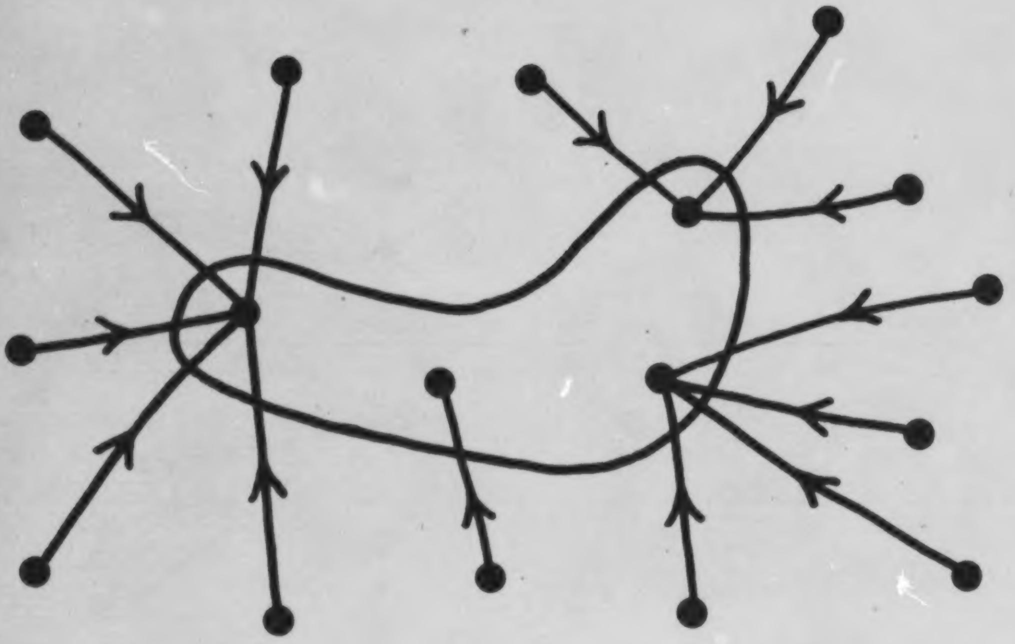
Point to two chicks who have the same mother.

(Point to a dot for a hen.) How many chicks does this mother have?

Point to all the hens. How many of them are there? (Four)

Ask someone to trace a string that goes around all four hens. When this has been done correctly, draw the string yourself as follows:

K28



T: Point to the hen who has the most chicks.

Point to the hen who has the fewest chicks.

Count how many chicks there are. (13)

K29

TITLE: One-to-One Correspondence #1

MATERIALS:

Teacher - Demonstration Minicomputer checkers; a magnetic board* (see the note in Lesson K6)

Students - (Optional) Colored pens*, pencils* or crayons*; paper*

DESCRIPTION OF LESSON:

Activity 1:

Place six red checkers on your magnetic board:

T: These red checkers are for children. How many of them are there? (Six) Now I am going to put up some blue checkers. They are for Christmas presents (or candies, or toys, ...).

K29

T: How many presents are there? (Five) Right. Six children and five presents. In a moment, we are going to give the presents to the children. What do you think will happen?

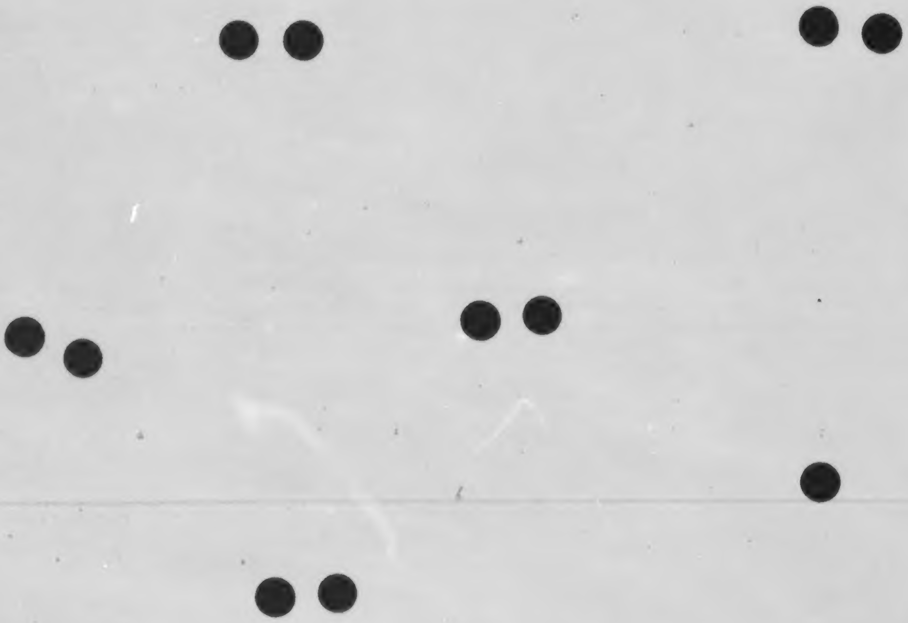
Give the children a chance to react to this question, but don't indicate whether you agree or disagree with what they suggest.

T: Let's see what happens. This child gets this present.

Move one of the blue checkers up next to one of the red ones.

Let several students come to the board one at a time and finish pairing off the children and the presents. When this has been completed, your magnetic board will look something like this:

K29



Let the children react to this situation. They will surely see that one child didn't receive a present. Once they have had sufficient time to realize this, ask:

T: Does every child have a present? (No)

Have all the presents been given away? (Yes)

Conclude the story as follows:

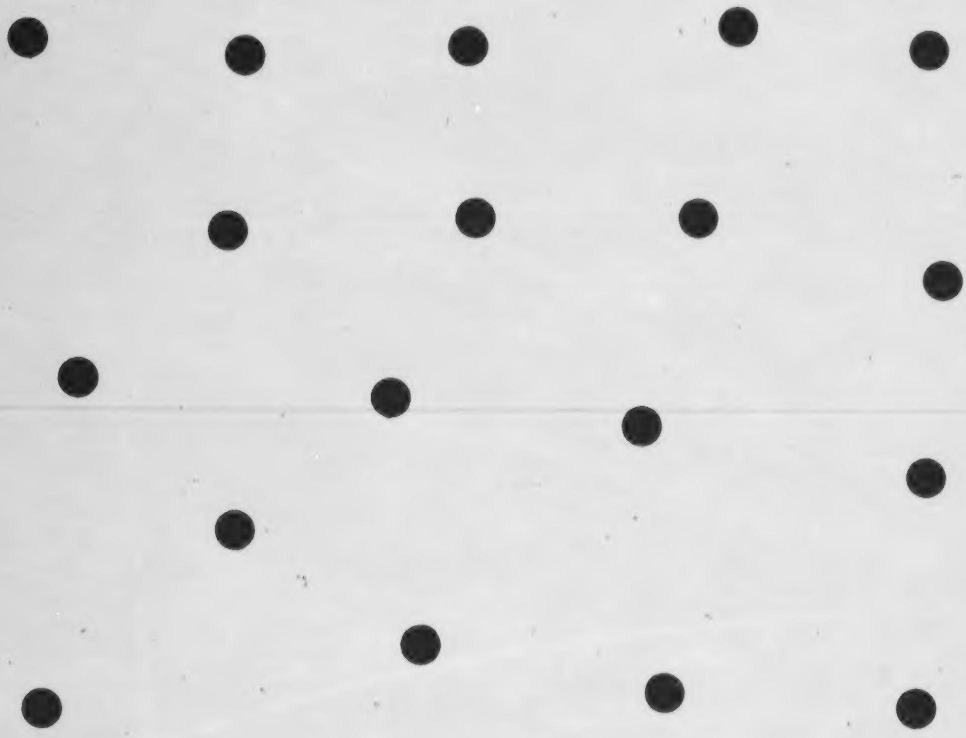
T: In my story there are more children than toys. How many more? (One)

Remove all the checkers from the board.

Activity 2:

T: This is another "children and presents" story.

Place eight red checkers and ten blue ones on the magnetic board:



As in the first activity, let the students count how many red checkers and how many blue checkers there are.

T: Are there more children or more toys?

S: More toys.

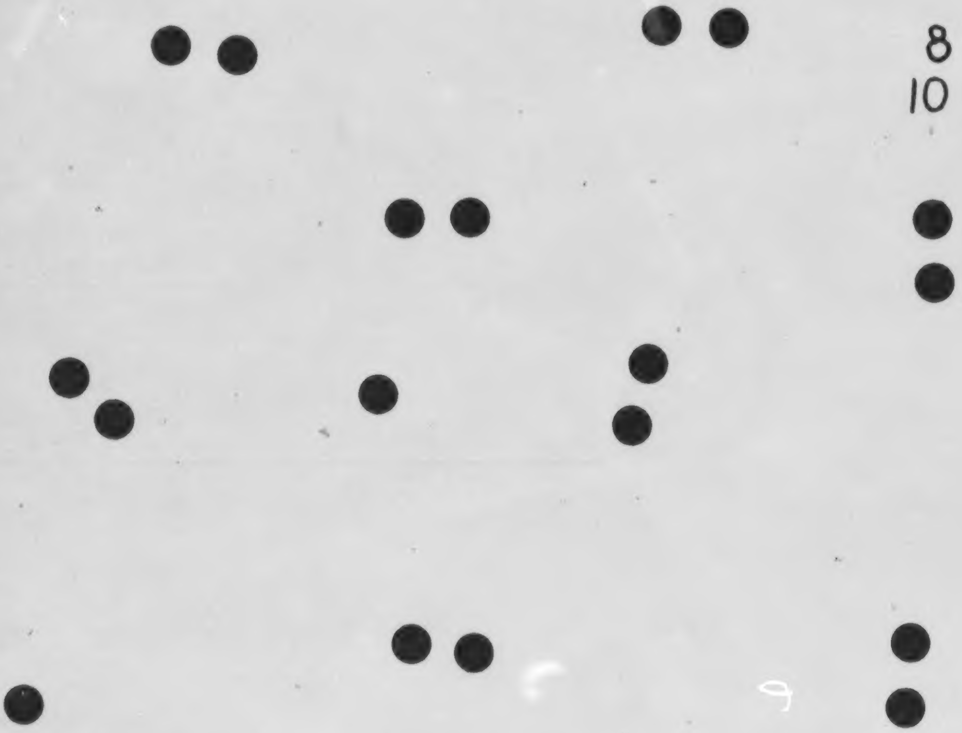
T: How many more?

Don't worry if no one is able to answer this question. Just proceed as follows:

K29

T: Let's check.

Let some of your students quickly pair off the children and the presents.



T: Does every child have a present? (Yes)

Have all the presents been given away? (No)

So you were right; there are more presents this time.

How many more? (Two)

Remove all the checkers from the board.

Activity 3:

Start this activity only if you have time. Distribute paper and colored pens, pencils or crayons.

T: In my first story there were more children than presents.

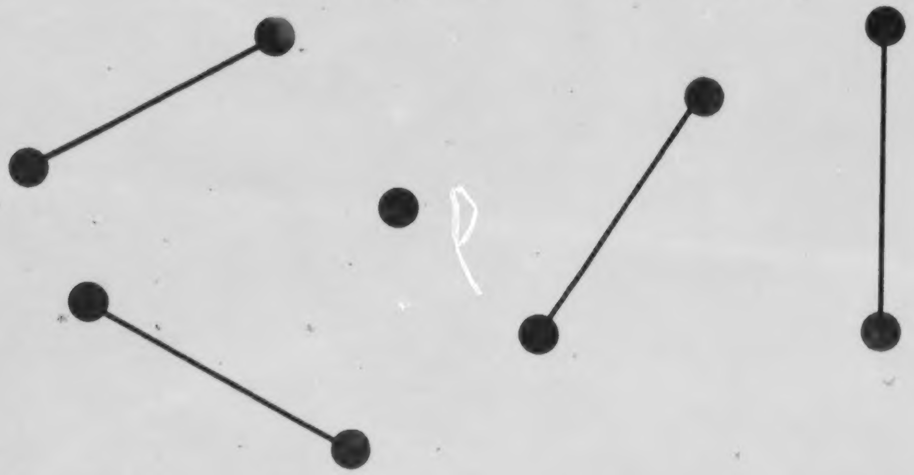
In my second story there were more presents than children.

I would like you to draw a story with exactly the same number of presents as children.

Once this has been done, let some children hold up their papers and let the rest of the class make comments about them.

IMPORTANT NOTE:

If a child has drawn red and blue dots all over the paper, and if there is not the same number of red and blue dots, help that child check his or her work by pairing off the dots. For this purpose you could draw a stroke between each pair of dots. The child's drawing might look like the following:



EARLY WARNING:

For Lesson K30 you should collect together various solids. See the note at the beginning of the lesson for details.

K30

TITLE: Solids #1

MATERIALS:

Teacher - Various solids* (see the note below)

Students - None

IMPORTANT NOTE:

Before this lesson you should collect together various solids. These can be items such as pieces from educational toys and games that you might have in your classroom or in the school mathematics laboratory. But they can also be articles from the home, packages, and so on. You should have at least some of each of the following:

- Rectangular "blocks": Boxes (with their lids on); construction game pieces; etc. Be sure to include at least one cube.
- Spheres: Balls.
- Cylinders: Cans of different sizes (with their lids).
- Any other solid: (This category is optional.) Hard boiled eggs, cones, pyramids. (If you decide to use an ice cream cone, tape a circle over its base or fill it up with Play-doh or clay.)

Keep these solids available; you will need them again in Lesson K42.

DESCRIPTION OF LESSON:

Activity 1: Free Play.

Allow the children to spend 5-10 minutes playing with the solids. You might want to divide your class into small groups and give a small collection of solids to each group.

Activity 2: Do They Look Alike?

Call all the groups together again and ask your students to sit down in a large circle with the solids laid out in the middle.

T: I would like someone to pick out two solids that he thinks look more or less alike (or that have something in common).

Let several children volunteer, pick up two solids, and explain how they are related.

Be flexible! The features by which you compare two solids might not seem very significant at all to your pupils, and vice versa.

It is perfectly correct, for example, for a child

- to pick up a cube and some other box with the explanation that they are both boxes;
- to pick up a sphere and a cylinder because they both roll or because

you can "see circles in them";

and so on.

However, if someone picks up a ball and a box with the explanation that they are both red, make it clear that you are interested only in the shapes and not in the colors.

Do not use technical or adult names for the solids. However, you should refer to them as "solids" (not as "shapes"), and, if you want to talk about the "sides," call them faces.

For instance, you might want to point out that two boxes look similar because "their faces are rectangles."

Activity 3: Similar Solids.

Start this activity only if you have time.

Pick up one of the solids and ask if the children know of any other objects whose shape is similar to the one you are holding up.

Similarities such as the following might be suggested:

- Sphere: a ball, an orange.
- Cube: a die, a particular sort of box.

K31

TITLE: K - A Blocks #5

Repeat Lesson K17.

K32

TITLE: Number Readiness #4

MATERIALS:

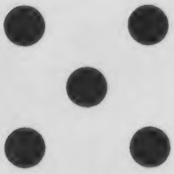
Teacher - Colored chalk*

Students - None

SUGGESTED ACTIVITIES (see the introduction to Lesson K3):

A. How Many?

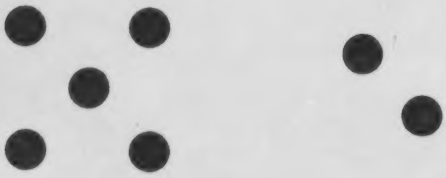
Draw five dots on the board, as follows:



T: Here are some children playing in a park. How many are there?

S: Five.

Draw two more dots:

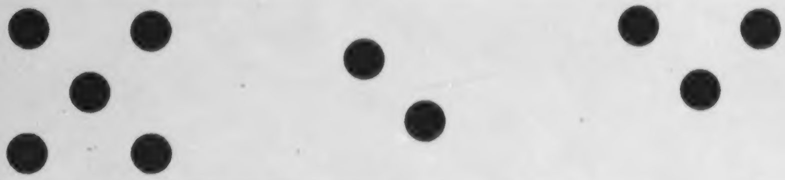


T: How many are there now?

Encourage the children to answer this question without starting to count from one again. If they can't answer immediately you might provide some assistance by indicating the first five dots, and then pointing to the other two and counting "six, seven."

T: Here come some more children.

Draw three more dots:



S: Three.

T: Right. Three more. How many children are there altogether now? (Ten)

Use the same "counting on" technique as before. Afterwards, if you feel your group is unsure about the method you have used, you could let a child count by ones as a check.

T: It is getting dark and one by one the children are going home. Remember, there are ten of them. One goes home. (Erase one dot.) How many are left?

Continue to erase the dots one at a time, each time asking how many students are left.

Afterwards ask a child to point to "10" in the Numeral Row, and to count backward by ones.

B. Orchestra

Repeat Lesson K18-1.

EARLY WARNING:

For Lesson K33 you will once again need a copy of the Robot Walk Grid and the small doll you used in Lesson K19.

K33

TITLE: **Robot Walk #2**

MATERIALS:

Teacher - A copy of the Robot Walk Grid (see the note at the beginning of Lesson K19); demonstration Minicomputer checkers; a small doll* (a robot, a fireman, or a policeman, etc.)

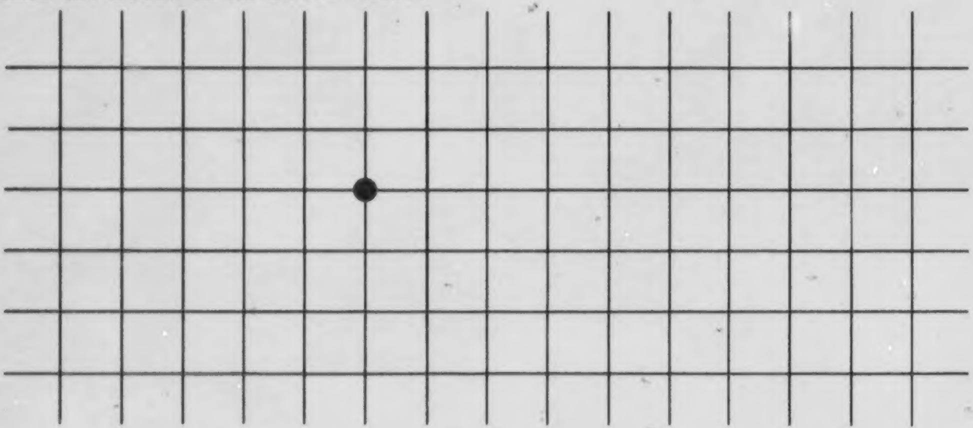
Students - None

DESCRIPTION OF LESSON:

Set up your class in the same way as you did in Lesson K19, and remind the children of the rules which were explained on the occasion of that lesson.

Activity 1:

Place the robot on an intersection.



Choose one child to be the robot operator. Give the directions to the operator yourself, one at a time.

Phrase your directions like this:

Forward two steps

Turn to the window[***]

Back one step

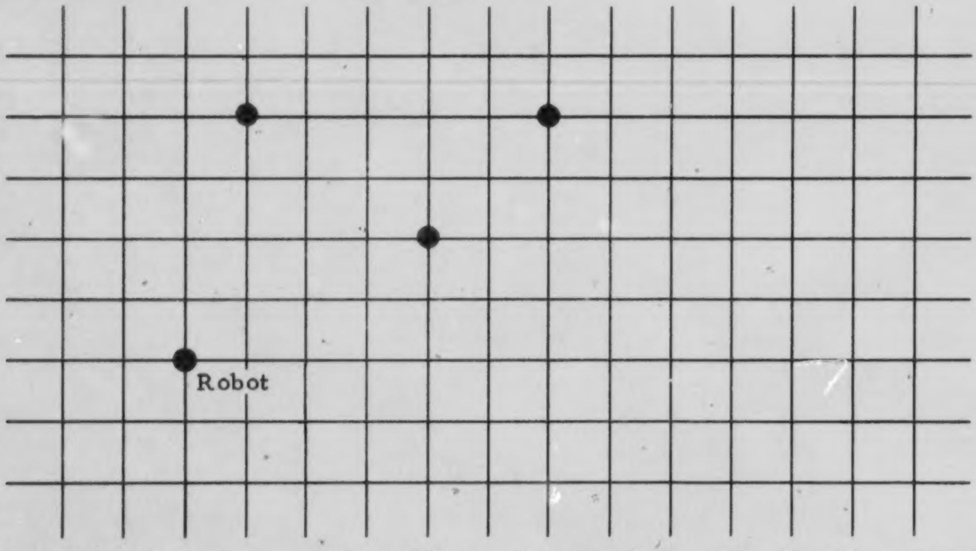
Turn to the chalkboard[***]

and so on.

This activity is just a reminder. Keep it short!

Activity 2:

Place the robot on one intersection, a red checker on a second intersection, and some blue checkers on other intersections.



One child is the robot operator while another child gives the directions (still one at a time).

The goal of the activity is for the robot to reach the red checker while avoid-

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[***] As in Lesson K19, do not give commands such as "turn to the right" or "turn to the left."

ing the blue ones (obstacles).

As in Lesson K19, directions which, if obeyed, would send the robot off the portion of the grid which you have displayed are illegal. So also are directions that would force it to run into a blue checker. For example, for our placement of checkers above (and provided the robot starts off facing "north"), the following sequence of commands leads to an illegal move:

Forward four steps
Turn toward the red checker
Forward one step.

As suggested in Lesson K19, when a child gives such a direction

- the whole class should be encouraged to protest (by raising both hands, for example)
- the robot ignores it, and
- the child who gave the direction has to pass on the responsibility for giving directions to someone else.

Activity 3:

The situation is the same as in Activity 1, but this time you give the directions yourself, all at once. The robot operator has to listen first, then to carry out the directions.

Begin by using short sequences of easy directions such as:

Forward two steps
Turn to the window

Forward one step.

If the robot operator makes a mistake in following the directions, the whole class should protest (by raising their hands, for example). In such a case, repeat the directions one at a time so that the robot operator can correct his or her mistake.

TITLE: One Way Roads #1

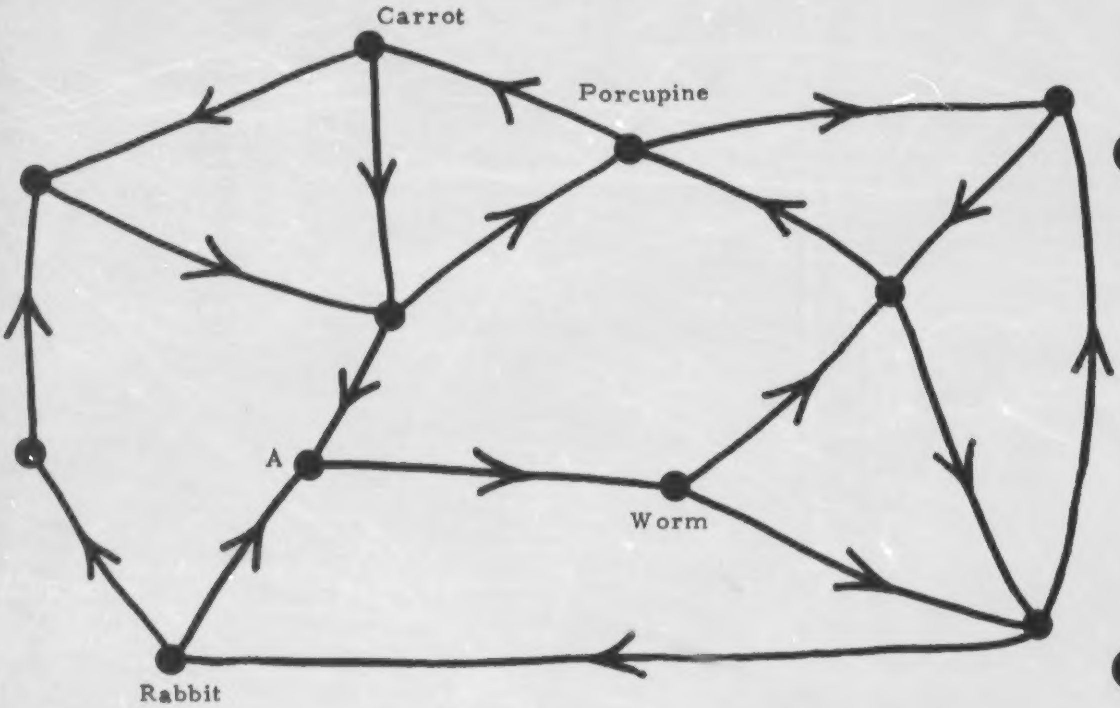
MATERIALS:

Teacher - One Way Road Map #1; demonstration Minicomputer checkers; a pointer*; scotch tape*

Students - None

DESCRIPTION OF LESSON:

Tape your copy of One Way Road Map #1 to the board. Do not copy onto your map the words that appear in the reproduction below. We have included them there purely for your reference later in the lesson.



T: This is the map of a forest. But it is a very special forest, because if you want to walk in it, you have to follow the arrows.

If you think that clarification is necessary, point to two dots which are at the ends of the same arrow and ask someone to indicate in which direction you are allowed to walk between those two dots.

T: Who would like to take a walk through this forest starting right here (point to dot A)?

Let several children indicate where they would like to walk by tracing along a sequence of arrows using a pointer. When a child makes a mistake (by going against the direction of an arrow), he or she has to stop and let somebody else take a walk. While this is going on, and indeed throughout the lesson, the rest of the class can be involved by pretending to be forest guards and protesting (for instance, by raising both hands) when someone tries to go the wrong way along an arrow.

After several children have had this opportunity to wander freely through the forest, proceed with the story as follows:

T: In this forest there lives a rabbit. The rabbit lives right here (tape a checker on top of the dot that is indicated in the picture on the previous page). And here is a big, juicy carrot (tape a checker of a different color on top of the dot indicated in the picture on the previous page). Can anyone help the rabbit reach the carrot?

When someone has found a correct way, ask for someone else to show another way, and a third person to show yet another way. Then remove the two checkers.

T: In this forest there also lives a porcupine. His den is right here (tape a checker on top of the indicated dot). Just now, he spotted a long, fat worm, right here (tape a checker on top of the indicated dot). Can you help him catch it?

Once again, let several people show different ways of solving the porcupine's problem.

EARLY WARNING:

Lesson K36-1 calls for a very large sheet of translucent paper (such as low grade wrapping paper); finger paint (two colors); one glove for each student (these should not be mittens, and should be able to be turned inside out easily - woolen gloves would be very suitable); a protective apron or smock for each child. Make sure all these items are available before you begin the lesson.

K35

TITLE: Ways to Make Eight

Repeat Lesson K9.

K36-1

TITLE: One Side - Two Sides #1

MATERIALS:

Teacher - A very large piece of translucent paper* (such as low grade wrapping paper); two jars of finger paint* (two different colors, red and blue, for example); a bowl of water* and some paper towels*; newspapers* and an apron* (to protect the floor and yourself, respectively)

Students - A protective apron* or smock* and one easily reversible glove* (not a mitten) per child

Optional: If you decide to do Part 1 of this lesson a small group at a time, the children will need something to be working on while they are waiting to make their handprints. For example, you could use the "Coloring By Numbers" pages from Lesson K36-2. If you take this option, each child will also need some colored pencils* or crayons.*

ORGANIZATION:

To begin with, this lesson is more like an art lesson in which you use finger paint. If your children are used to working with finger paint, and you have your own way of organizing this kind of activity, stick to it!

If this is not the case, we suggest you do not attempt to work with the whole group all at once; unless you could secure some additional help (such as a teacher aide, a student teacher, or a parent), such an arrangement would probably result in a considerable amount of mess and confusion.

What you should do instead is start everyone on some activity on which the children can be working individually (the activity suggested in Lesson K36-2 is one possibility), and then you can call on three or four children at a time to come and make their handprints on the large sheet of paper: right hands in red, left hands in blue.

As soon as the children have made their handprints, they should

1. pick up a paper towel and wipe most of the paint off their hands
2. wash their hands thoroughly
3. go back and continue work on their individual activity.

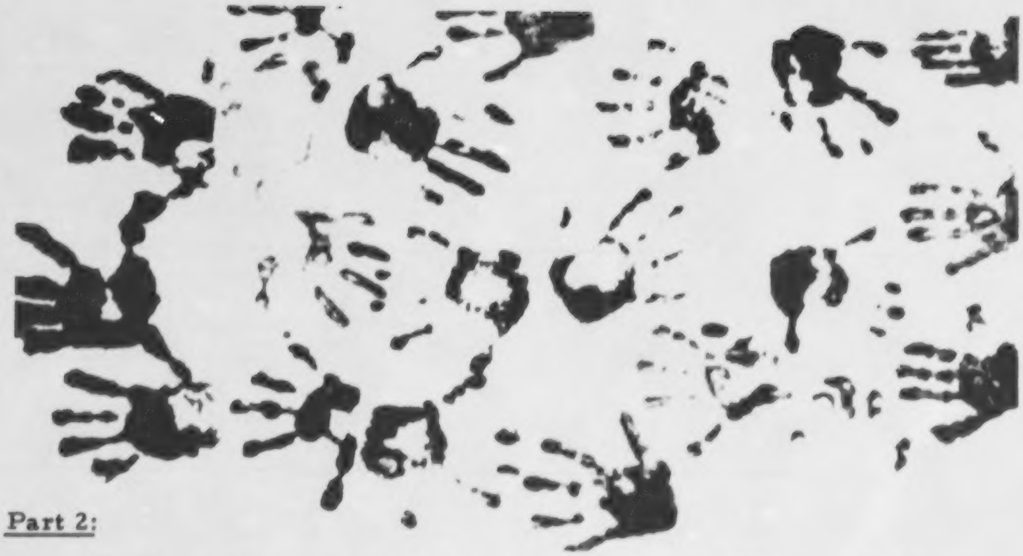
DESCRIPTION OF LESSON:

There are three parts to this lesson.

Part 1:

When children come to the front, they should make their handprints anywhere they like on the large sheet of paper. There is just one rule: all the right handprints should be made in one color (e.g., red), all the left handprints in another color (e.g., blue). When everyone's handprints have been taken, let the picture dry.

The following picture shows the work of one St. Louis class of children.



Part 2:

Later in the day, when the picture is dry, remind the children about the picture. Remind them that all the red handprints were made by right hands and all the blue handprints were made by left hands.

Turn the paper over, hold it up to the light and ask your students what they notice (the paper should be translucent so that it is possible to notice something at this point!). When viewed from this reverse side, what can be seen in blue will fit right hands, and what can be seen in red will fit left hands.

SAVE THIS HANDPRINT FRIEZE FOR USE IN LESSON K48: Mirror Symmetry #2.

Part 3:

Give each child a glove. Let them try their gloves on to find out which hand they fit. Then they should turn their gloves inside out and try them on again. (The reversed glove fits the other hand!)

TITLE: Coloring By Numbers #1

MATERIALS:

Teacher - Colored chalk*

Students - Worksheets K36-I, II, III, IV, V; colored pencils* or crayons*

IMPORTANT NOTE:

It is not intended that all your students color all five of the worksheets provided with this lesson at one sitting. Indeed, it is not at all unusual for a child to spend several days working on a single such worksheet. One more lesson (K57) is scheduled in which these worksheets are to be used. After Lesson K57 you should feel free to use the remaining worksheets at any time, either collectively, individually or in small groups.

DESCRIPTION OF LESSON:

Distribute the worksheets (either you can start everyone on Worksheet K36-I, or else you can provide each child with the one of the five worksheets which you think is most appropriate to his or her capabilities).

In what follows we assume that you have given everyone Worksheet K36-I. A similiar dialogue will take place if you choose the other alternative.

T: If you color the little squares in the right colors, you will get an interesting picture.

Look at the color key at the bottom of the page. What numbers are mentioned there?

S: 5 and 7.

T: What color should we color all the squares marked with a "5"?

S: Green.

Write a green "5" on the board.

T: What color should we color all the squares marked with a "7"?

S: Brown.

Write a brown "7" on the board.

Here is a full color chart covering all five worksheets:

1	Red	5	Green
2	Yellow	6	Purple
3	Blue	7	Brown
4	Orange	8	Black

9 White*

If you are using this as a parallel, individual activity at the same time as you are doing Lesson K36-1, then, once everyone has started coloring, start to call three or four children at a time to add their handprints to the class frieze.

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* "Coloring a square white" means "don't color it at all."

K37

TITLE: K - A Blocks #6

MATERIALS:

Teacher - One set of K - A blocks (see the note in Lesson K8); a box*

Students - None

DESCRIPTION OF LESSON:

Activity 1: Comparison Contest.

Pick out two pieces at random. The students are to give at least one way in which the two pieces are alike and at least one way in which they are different. As this game is played, the students will build up a repertoire of comparisons and contrasts. You can then increase the difficulty of the game by asking for more ways in which the pieces are alike and different.

Activity 2: The Piece in the Box.

Place one of the pieces in a box so that it can neither be seen nor felt. The task is for the students to ask questions until they are able to identify which piece is in the box. Here is how the dialogue might go when a big, green circle is placed in the box:

S: Is it red?

T: No, it is not red. That was a good question, though.

S: Is it a square?

T: No, it is not a square.

S: Is it a green triangle?

T: No.

S: Is it green?

T: Yes, it is green.

S: Is it big?

T: Yes, it is big.

S: Is it a red circle?

T: No. If you have been listening carefully, you already know two things. You only have one more to find.

S: Is it a circle?

T: Yes, it is a circle. Now we know all three things. Who can put them together?

S: A small, green circle.

T: Almost!

S: A big, green circle.

T: Yes!

Take the piece out of the box and show it to the children.

There are at least two important ideas that students can develop by engaging in activities such as these. First, getting a "no" answer to a question is not equivalent to failure. Instead, a "no" answer can give just as much information as a "yes" answer. Another important idea for the students to learn is how to ask useful questions. The procedure of first eliminating entire classes of objects instead of individual objects is a useful one. The initial question, "Is it a small green square?" is not going to give very much information if the answer is "no." As an initial question, "Is it green?" will give a lot of information no matter what the answer is. Of course, it will take time for your students to discover this sort of thing. Be patient; do not expect learning to occur instantaneously. The way you give your answers is important. Be sure to answer useful questions with a full sentence (for example, "No, it is not a square"). This will give everyone a second chance to hear what the question was.

If your students enjoy this game, feel free to play it again and again on various occasions as a short activity.

TITLE: Centimeter Rods #5 (Designs)

MATERIALS:

Teacher - None

Students - One set of centimeter rods* per one, two or three children

DESCRIPTION OF LESSON:

Start the lesson by allowing the children to play freely with the rods for a few minutes. Tell the children that you want them to make some designs with the rods, but only using the ones that you are going to specify (make this sound as though it's a challenge).

T: Take out just your red rods and your light green rods.

Make a design with them.

Give the children time to make their designs, and then to tell you something about them.

T: Now, I would like you to make another design, but this time using exactly five red rods and three light green rods.

As you circulate among the children, admiring their creations, ask casually:

T: How many rods are there altogether?

S: Eight.

T: Right. Five plus three equals eight.

Now, make another design using exactly four light green rods and more

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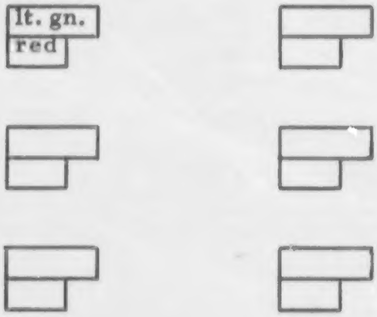
than four red rods.

Once again, walk around the room to make sure that this instruction is carried out faithfully.

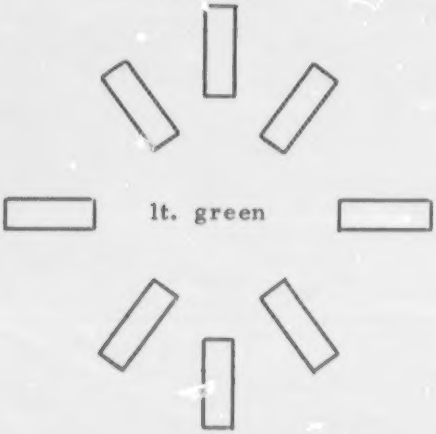
T: One last problem: I would like you to make a design in which you use exactly the same number of red rods as you do light green rods.

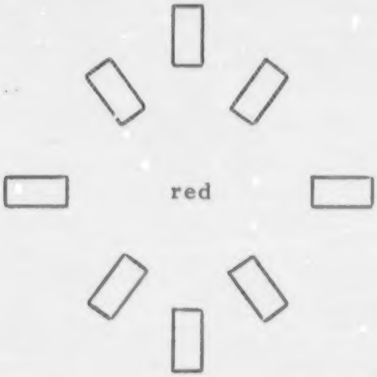
IMPORTANT NOTE:

It might happen that, in this last case, a child makes a design in which you can see at a glance that there are the same number of red rods as there are light green rods. For example,



or





If this happens, make the rest of the class aware of it by saying:

T: I like your design, Mary. We can see at once that there are as many red rods as there are light green rods, can't we?

A similar remark applies to the penultimate situation in which you asked the children to make a design using exactly four light green rods and more than four red rods.

SUMMARY OF THIS LESSON:

1. Free play.
2. Make a design using just the red rods and the light green rods.
3. Make a design using five red rods and three light green rods.
4. Make a design using exactly four light green rods and more than four red rods.
5. Make a design using exactly the same number of red rods as light green rods.

EARLY WARNINC:

Lesson K39 calls again for a square grid. See the note at the beginning of Lesson K27 for details.

K39

TITLE: Taxi-Geometry #2

MATERIALS:

Teacher - A square grid* (see the note at the beginning of Lesson K27); colored chalk*

Students - None

IMPORTANT NOTE:

This lesson follows exactly the same plan as that of Lesson K27 (you will need to read that lesson over again) with a single difference: toward the end of the lesson, it is the pupils (not you) who should count how many blocks long the paths are.

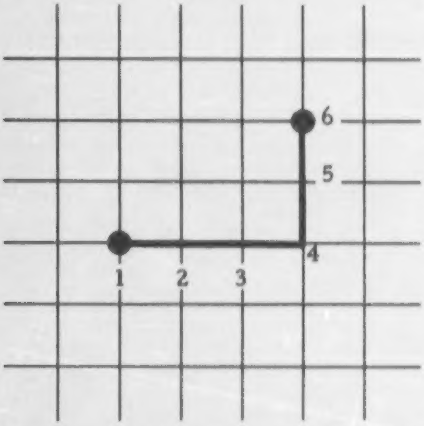
PLAN OF LESSON (see Lesson K27 for details):

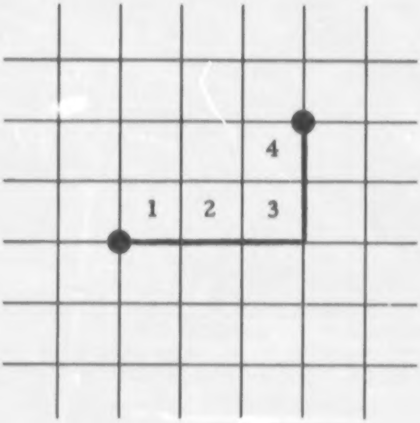
1. Reminder of the situation. As soon as you display the square grid, several students will probably volunteer what they remember about it. Make sure everyone knows that "Nick is only allowed to walk along the streets."
2. Different routes from Nick's house to Nick's school, both long and short.
3. Which path is longest?
4. Check the lengths of the paths by counting how many blocks long they are. (Don't forget to record the unit "$\overset{1}{\vdash\!\!\!-\!\!\!-\!\!\!\dashv}$" namely, one block on the grid.)

This time let students come up and indicate the blocks as they count them.

Do not be surprised if this is a little difficult to begin with. In fact, some very common mistakes occur when students start to count blocks.

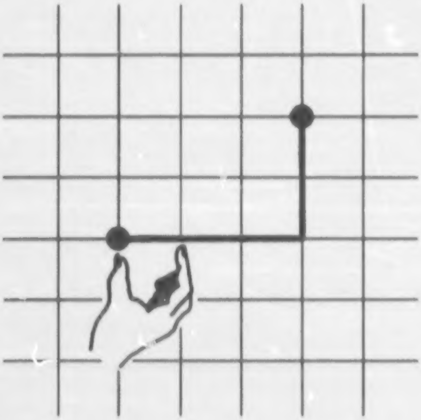
For instance:





In fact, this is a five block path!

To avoid Mistake A (counting the starting point as "one"), you could emphasize that you are supposed to be counting the blocks, not the points. It may also be helpful to ask your students to designate each block with their thumb and index finger as it is counted. This is illustrated in the following diagram:



K39

Mistake B (counting squares instead of street blocks) can be avoided by insisting that the students follow the paths very carefully (with a pointer or with both their thumb and index finger) as they count.

TITLE: "The Baby Is Born"

MATERIALS:

Teacher - One copy of the storybook, "The Baby Is Born"

Students - One copy of the storybook, "The Baby Is Born," for each pair of students; colored pens,* pencils,* or crayons*

(Optional) If you have not purchased additional copies of the book so that each child may keep one, a sheet of paper* for each student will be necessary.

DESCRIPTION OF LESSON:

"The Baby Is Born" uses the nonverbal languages of dots, arrows, and strings to tell a story which may strike a chord for many of your students. It deals with the birth of the second child into a family and the emotional stress this event places on the firstborn.

Read this story as you would read any other story to your children. If you think that your students will be able to follow along in their books as you read the story, you could distribute copies of the storybook at once. However, if you do not do this, be sure to give the children an opportunity to look at the few realistic pictures by holding up your own copy of the book at the appropriate times. The mathematical pictures are simple enough that they can be drawn on the board as you are reading the story. (Remember, when reproducing these pictures on the board, to use the side of a small piece of chalk to draw large dots and thick strings.)

Take care not to interrupt the flow of the story: it is probably simple enough that everyone can understand it without any additional explanation. Above all, make sure you give the children enough time to look at the drawings, particularly the mathematical ones, since they carry quite a lot of information. One exception to this admonition: on page 12 it is probably a good idea to ask "What has happened?" before you read the text.

When you have finished reading the story, don't rush the children into another activity. Instead, give a copy of the storybook to each pair of children (unless, of course, you have distributed them already), and let them look through it again at their own pace.

Then, having reached page 25, let them draw a picture of Veronica and her family. If each child is going to be able to keep a copy of the book, this drawing could be done in the books themselves. If not, you should give the children some paper on which to draw this picture. (You might find it useful at this point to ask someone to remind everybody who the people in Veronica's family are.)

When this drawing has been completed, let your students draw a picture of their own family, either on the next page of the book (in the first case above), or on the back of the sheet of paper (in the second). You should be prepared to help your slower students or children who belong to very large families.

Both of the drawings that the children make will probably be realistic. This is perfectly acceptable. If, however, a child decides to use dots and arrows instead, he or she should be free to do so.

Your children would enjoy it greatly if they were able to have a copy of the storybook to keep. This can be arranged if your school is prepared to buy sufficient additional copies of the book so that you have one copy for each child. However, if it is not the intention of your school to purchase a new set of storybooks each year, once your children have had ample opportunity to look through the book and make the above-mentioned two drawings, collect them so that they can be reused next year.

There is a narration tape* available for the story "The Baby Is Born." On some other occasion, you could listen to it as a class, or you could let the children listen to it individually at any time during the year. In any case, at least one copy of this storybook (with or without the accompanying tape) should be available for children who wish to glance through it in their spare time.

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* This tape may be obtained by sending a blank 30-minute cassette tape to CEMREL-CSMP. The recorded tape will be returned to you free of charge. Please be sure to mention the title of this story in your request for the tape to be recorded, and include a stamped, self-addressed envelope.

K41

TITLE: One-to-One Correspondence #2

MATERIALS:

Teacher - Demonstration Minicomputer checkers (of two colors); a magnetic board* (see the note at the beginning of Lesson K6)

Students - None

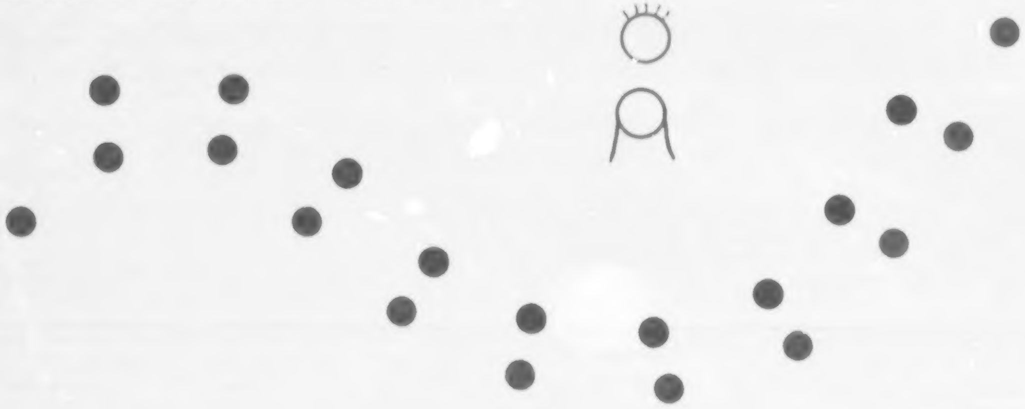
IMPORTANT NOTE:

When you place your checkers on the magnetic board, try to adhere as closely as possible to the arrangements shown in this lesson plan.

DESCRIPTION OF LESSON:

Activity 1:

Place a number of red and blue checkers on the magnetic board as follows. It is not necessary for you to use exactly the same number of checkers as in this picture. What is important, however, is that there are obviously two more blue checkers than there are red.



T: These checkers are for some children who are taking part in a dance. The red checkers are for girls and the blue checkers are for boys.

At this point, you could rapidly make a stylized drawing of a boy's head in blue and one of a girl's head in red, as in the picture above, to act as a reminder.

T: What do you notice?

Give the children time to react.

T: Are there more girls or more boys in this dance?

S: More boys.

T: How many more?

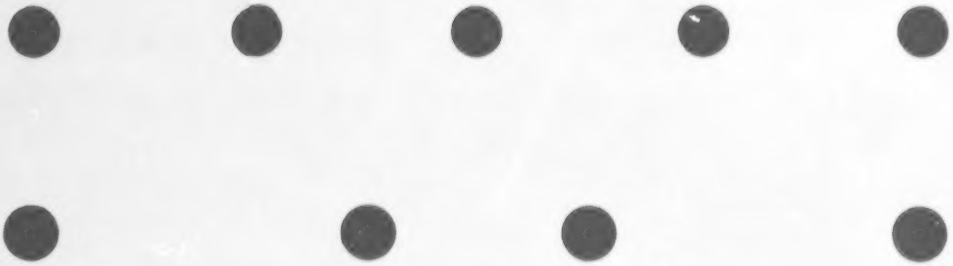
S: Two.

T: Fine, how did you find out?

Someone will probably explain that two of the boys don't have a partner. The important point to be emphasized is that you don't have to count all the boys and girls to find out how many more boys there are than girls.

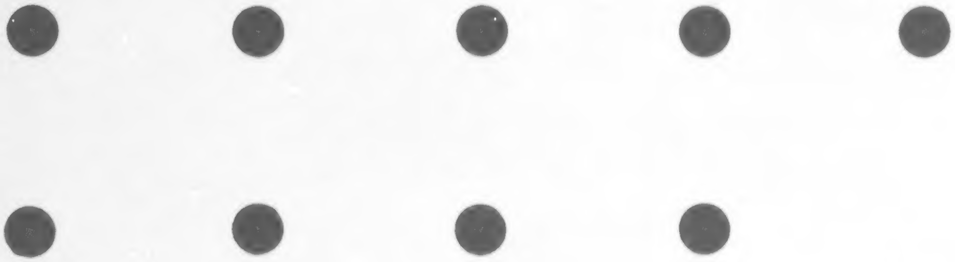
Activity 2:

Place checkers on the magnetic board as follows. Make sure that the first blue checker is directly below the first red checker, and similarly for the last blue and red checkers.



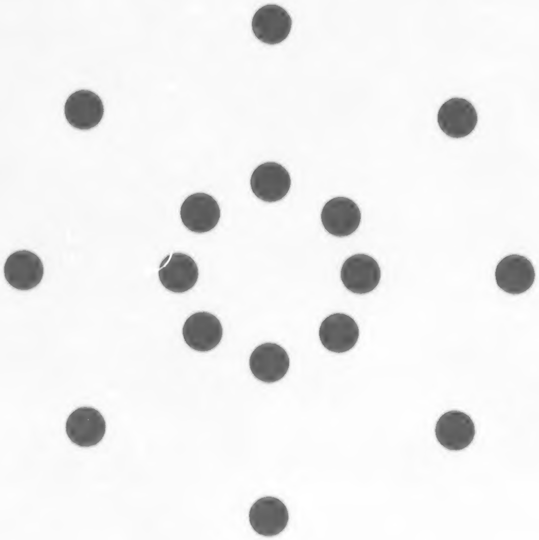
T: What about this dance? Are there more boys or more girls?

If there is not unanimous agreement that there are more girls this time, pair the checkers off:



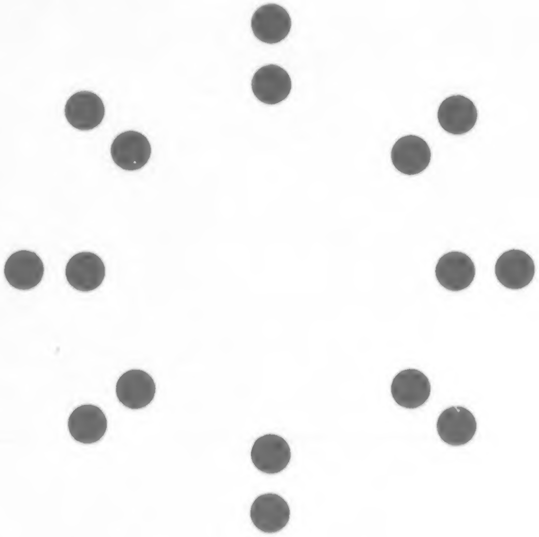
and conclude that there is one more girl than there are boys.

Activity 3:



T: What about this dance?

Once again, if everyone does not agree that there are the same number of boys as girls, pair off the checkers.



Activity 4: **Fingers.**

T: Each of you, show me five fingers;
more than five fingers;
less than five fingers.

Each of you, show me three fingers;
more than three fingers;
less than three fingers.

Each of you, show me three fingers on one hand and, at the same time, three fingers on the other hand. How many fingers altogether? (Six) Could you show me six fingers some other way?

You could record the different ways that are found on the board:

$$3 + 3 = 6$$

$$4 + 2 = 6$$

$$5 + 1 = 6$$

EARLY WARNING:

In Lesson K42 you will once again require the various solids that you collected together for Lesson K30. In addition, you will need either an overhead projector or a sandbox. Make sure these items are available before you start the lesson.

TITLE: Solids #2

MATERIALS:

Teacher - The solids* that you collected together for Lesson K30; if this collection does not already include several cubes, make sure you have some available. Either an overhead projector* (for Option I of Activity 2), or a sandbox* (for Option II of Activity 2) - the sandbox could be a large, low cardboard box, filled with sand.

Students - None

IMPORTANT NOTE:

Although it is not the major purpose of these lessons about solids to teach the children sophisticated names for the solids concerned, you should use the correct terminology in cases where the children are likely to have heard the words before: cube, cone, cylinder, for example. Any technical vocabulary (such as "parallel," "axis," etc.) used in the description of this lesson is intended merely to permit a precise statement of what is happening. It is up to you to decide how much of it is suitable or appropriate for you to use with your children.

Activity 1: Observation.

Seat your children in a circle. Pass around a cylinder, and tell your students to look at it carefully. When the cylinder gets back to you, hold it behind your back and ask:

T: How many circles did you see on this solid? (Two***) Answer with your fingers.

Once everyone has indicated his or her answer, produce the cylinder again so that the answers can be checked.

Take out a cube, and ask whether the children know what it is called (they will probably be aware of this name because of their familiarity with ice cubes). Pass the cube around the circle. When it gets back to you, hold it behind your back and ask:

T: How many squares did you see? Answer with your fingers.

The answer is six, but it will probably be necessary to count them. Having done that, hold the cube behind your back again.

T: How many corners did you see?

The answer is eight, but once again it will probably be necessary to count them.

If most of the answers to these two questions are wrong, distribute some cubes and let the students count how many faces and corners each one has.

Next, pass a box around the circle. (Choose one whose faces are all obvi-

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*** If a child reacts by saying, "There are a lot more than two circles!" you should ask him or her to explain, because in one sense this is correct. If you slip a rubber band around the cylinder you can roll it up and down the cylinder in such a way that a whole succession of circles is seen.

ously non-square rectangles.) Ask the same questions as in the case of the cube.

Activity 2:

This activity attempts to relate solids and shapes either by means of projection (Option I) or by using the solids as stamps (Option II).

OPTION I: Using an Overhead Projector

Stand a cylinder on one of its flat ends on the glass of the projector:

T: What shape do you see on the screen?

S: A circle.

Now lay the cylinder down on its side:

T: And now?

S: A rectangle.

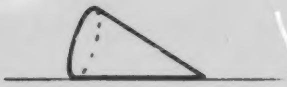
Next produce a cone.

T: What shapes do you think we could get with this solid?

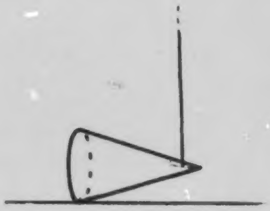
The answers which the children are most likely to suggest are:

- a circle, which is obtained by standing the cone on its base on the glass of the projector.
- a triangle. A child suggesting this probably has very good spatial visualization ability. Unfortu-

nately, most people's intuition is led astray at this point. What is usually suggested in order to obtain a triangle on the screen is to lay the cone down on its side on the glass. This will in fact produce something like a pie-slice, the curved part actually being part of an ellipse.



In order to obtain a triangle, you will have to support the "point" of the cone so that the axis of the cone is parallel to the glass of the projector. This can be done by taping a piece of string to the "point" of the cone and in this way suspending the "point" the required distance away from the glass.



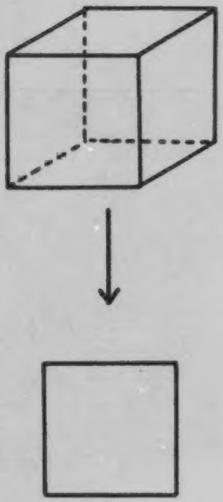
If someone suggests that a certain shape is possible, let him place the cone on the overhead projector in an attempt to obtain that shape.

If no one thinks of the triangle, show how it can be obtained yourself.

Repeat this procedure with a cube.

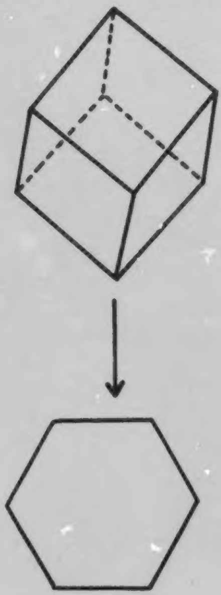
Some of the possibilities in this case are:

flat on one face



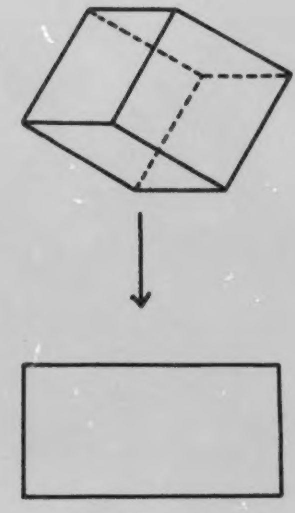
square

standing on one corner



regular hexagon

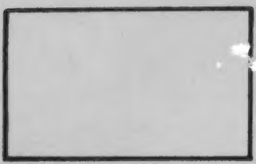
standing on one edge



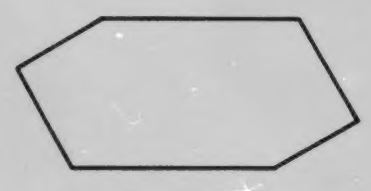
rectangle

In both these cases, suspend the cube in the stated position by means of a piece of string attached to an appropriate point of the cube.

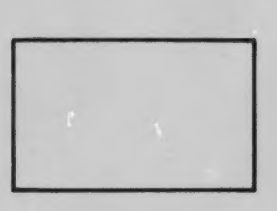
If you go on to repeat this procedure with a "box," then, for three positions similar to those given above for the cube, you will obtain:



rectangle



hexagon with opposite pairs of sides parallel



rectangle

No matter how you position a sphere on the glass of the projector, you will always obtain a circle on the screen.

If you place an egg on the glass, you either get an "oval": or a circle.

Move quickly from one solid or position to another; the children's enjoyment of this activity will depend on your offering them a brisk succession of shapes.

You should not expect your students to find all the possibilities for all of the solids. Nor should you expect them to be able to name all of the shapes that they do find.

If there are any possibilities that they overlook, show them yourself.

OPTION II: Using a Sandbox

In case you cannot secure an overhead projector, it is possible to organize a similar activity using a sandbox.* However, the possible shapes in this case will not be the same as in the overhead projector version.

Press the cylinder vertically into the sand.

T: What shape do we get?

S: A circle.

---

* The best type of sand to use is builder's sand, because this retains its shape better when solids are pressed into it. As an alternative to a sandbox, you could use a fairly small box (say, about 20cm x 15cm x 5cm) filled with flour. If you choose this alternative, the solids that you use will have to be correspondingly smaller.

Indicate with your finger the shape of the rim of the imprint made by the cylinder. This both helps those who have had difficulty in seeing the circle, and also serves to indicate that you are interested not so much in the three-dimensional hole made by each solid, but rather in the rim of its imprint (i.e., the shape that it cuts in the surface of the sand).*

T: Can someone print another shape with this cylinder?

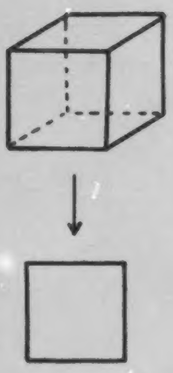
Using the cylinder on its side, you will cut a rectangle in the surface of the sand. Indicate with your finger the shape of the rim of the imprint. This rectangle starts off being long and skinny, but as you press the cylinder in further, the rectangle increases in breadth, reaching maximum width when the cylinder is half submerged.

Next produce a cube and ask the children what shapes they could "print" with it. The answers are more complicated than in the overhead projector version. We deal here only with the three positions mentioned in Option I. (Other positions of the cube as you press it into the sand will yield slightly modified shapes.)

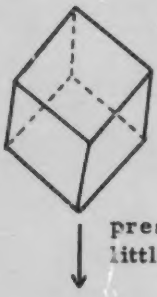
---

* If at this point (or for that matter, at any later point in this activity) some children seem not to understand what you are talking about, lay a piece of paper on top of the surface of the sand and very lightly trace around the rim of the hole cut in the surface of the sand. Remove the piece of paper, darken the lines of the tracing and tell the children that that is the shape you are talking about.

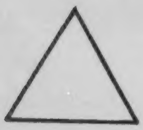
K42



square

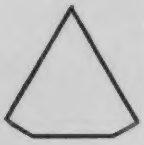


press in a little way



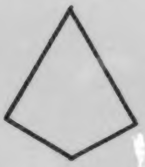
equilateral triangle

press in further



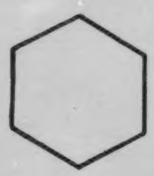
isosceles pentagon

press in further

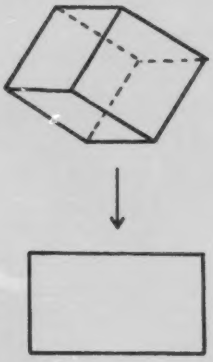


kite

press in further



regular hexagon



rectangle

This increases in width as you press the cube deeper into the sand until it is half submerged. At one point in this process, the rectangle will actually be square.

The possibilities with a "box" are similar to those with a cube. In this case, however, there are even more variations possible according to the different positions in which the box may be held as it is pressed into the sand. A catalogue of the possible shapes include: rectangles, triangles, pentagons, various kinds of quadrilaterals, hexagons (with opposite pairs of sides parallel), and so on.

A cone will produce any one of the three shapes that occurred in the overhead projector version of this activity.

A sphere will only give you a circle, although the further in you press the sphere the larger the circle, until the sphere is half submerged.

An egg will either give an "oval" or a circle, as in the overhead projector version.

For each solid, make sure you reinforce the idea that you are interested in the shape cut in the surface of the sand, not in the characteristics of the hole punched out in the sand.

EARLY WARNING:

In Lesson K43 each group of four children will need two pieces of string (or yarn) of different colors (each piece about 2m long). Before the lesson prepare each of these pieces of string by tying it so that it forms a loop.

K43

TITLE: Strings #1

MATERIALS:

Teacher - None

Students - Two pieces of string* (or yarn*) of different colors, each piece about 2m long; one set of K - A blocks for each group of four students (see the note in Lesson K8)

IMPORTANT NOTES:

1. Before the lesson begins, tie each piece of string so that it forms a loop.
2. In Activity 2, don't give away the secret of overlapping the strings. If no one thinks of it today, just leave the problem open. There is another lesson (Lesson K55) on this topic later on in the year.

DESCRIPTION OF LESSON:

Activity 1:

Move through this activity at a brisk pace.

Divide your pupils into groups of four and give each group a set of K - A blocks. Let the children play freely with the pieces for a few minutes while you give one loop of string to each group.

Once each group has a loop of string, ask your students to place all the green pieces in their group's set inside the string.

After this instruction (and indeed after each of the following ones), you should quickly check the children's work and then the students should be instructed to empty the strings again.

Continue by giving each of the following directions, one at a time:

1. Put all the triangles in the string.
2. Put all the pieces that have no holes in them in the string. (This time, each group should place all of its K - A blocks in the string.)
3. Put all the purple pieces in the string. (The string should remain empty.)

Activity 2:

This activity will almost certainly require a good deal more thinking than the preceding one!

Give each group a second string (let's suppose your strings are yellow and blue).

T: This time we are going to use two strings. What colors are they?

S: Blue and yellow.

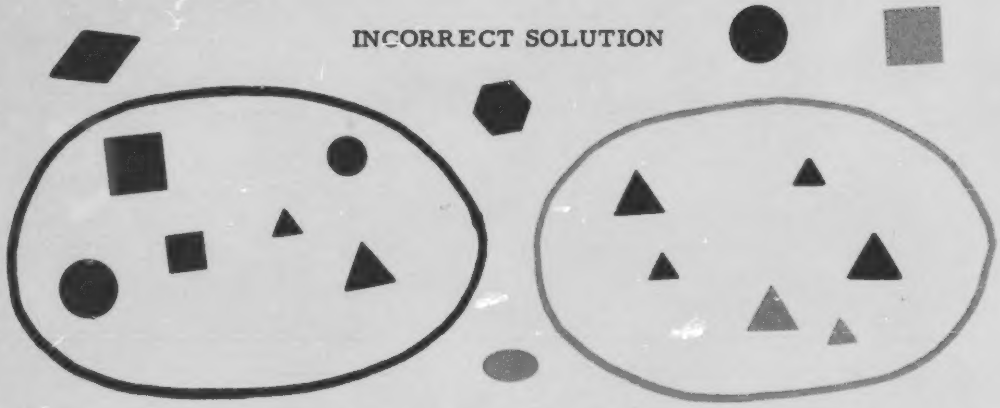
T: Fine. In the blue string, I want you to put all the red pieces. In the yellow string, I want you to put all the triangles.

You might ask one or two children to repeat these instructions, to make sure that everyone remembers them.

It is very unlikely that your students will be able to solve the problem on this, their first attempt.

They might suggest:*

INCORRECT SOLUTION

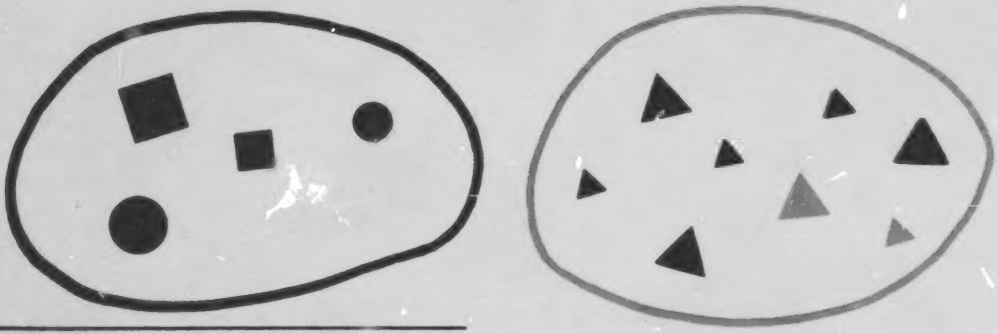


If this happens, point to one of the red triangles and ask:

T: Isn't this a triangle?

At this, the children will probably move all the red triangles over to the yellow string:

INCORRECT SOLUTION



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* Note: in this drawing (and in those that follow in this lesson) not all of the K - A blocks are shown.

T: Which pieces were supposed to go in the blue string?

S: The red pieces.

T: Are all the red pieces in the blue string?

S: No.

T: Think for a while ... there is a way of solving the problem.

WHAT CAN YOU DO TO BE OF ASSISTANCE?

Above all, do not overlap the two strings yourself!

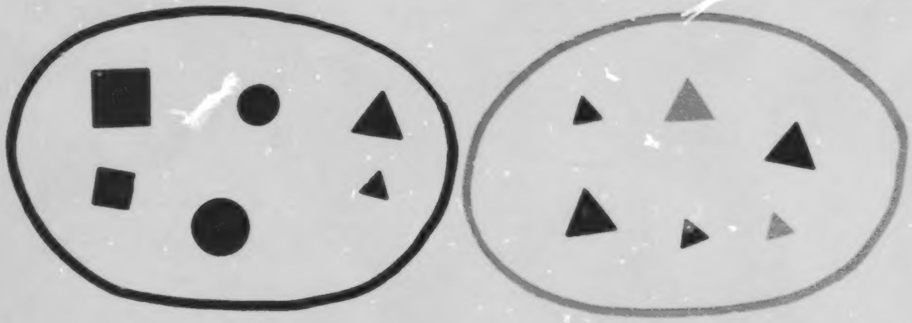
Here are two ways in which you could attempt to help the children make this discovery:

a) Point to a red triangle and say:

T: This is a triangle, so it should go in the yellow string. But it is also red, so it should go in the blue string too.

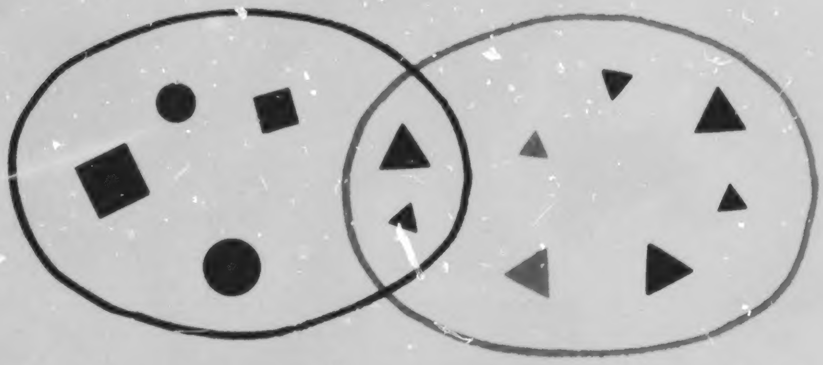
b) Move the strings right up close to each other, and place the pieces in question near the edge:

INCORRECT SOLUTION



This action might lead the children to discover the correct solution:

CORRECT SOLUTION

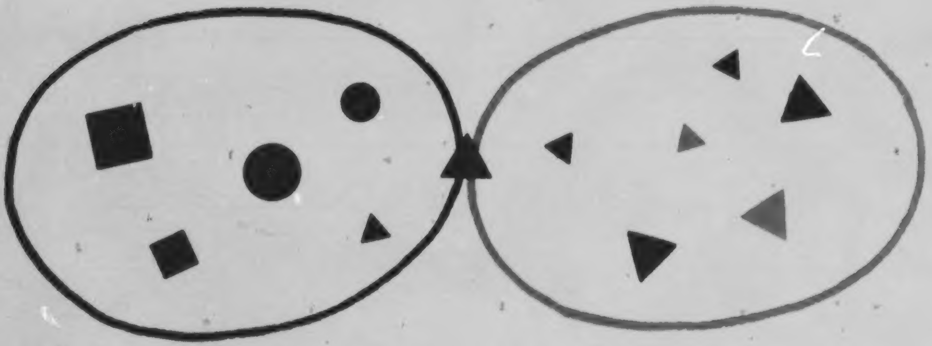


If no one makes this discovery, however, don't worry; this lesson is scheduled again at a later time.

IMPORTANT NOTE:

If anybody suggests something like this:

INCORRECT SOLUTION



tell them that this is a clever idea but you really want the red triangle to be inside both strings (not on top!).

SAVE THE STRINGS FOR LESSON K55.

TITLE: Number Readiness #5

MATERIALS:

Teacher - None

Students - None

SUGGESTED ACTIVITIES (see the introduction to Lesson K3):

A. Ten Children

Call ten children to the front of the room.

T: How many children are there? (Ten)

Write on the board: 10 children.

T: How many heads are there? (Ten)

Write on the board: 10 heads.

T: How many hands are there? (20; let the children answer right away, then check the answer by counting the hands by ones, then by twos.)

Write on the board: 20 hands.

T: How many feet are there? (20; if some children do not realize that there must be 20 feet since there were 20 hands, count the feet.)

Write on the board: 20 feet.

T: How many fingers? (100; once again let your students check by counting all the fingers first by ones, then by tens.)

Write on the board: 100 fingers.

Ask the ten children to return to their seats. As a follow-up to the last question, your students will probably enjoy finding out how many fingers there are in the whole room! This should lead to quite a challenging counting-by-tens exercise!

B. Last Year, Next Year

This activity is a "quickie." You should only pursue it for five minutes or so. Feel free to use it at any time during the year as a very short number activity.

T: Mary, how old are you?

Mary: Five.

Ask everyone to hold up five fingers.

T: How old will you be next year?

Mary: Six.

Ask everyone to hold up one more finger.

T:	My friend Julita is three.	Next year she will be ...?
	My friend Sam is seven.	Next year he will be ...?
	My friend Denise is six.	Next year she will be ...?

Either direct these questions to the whole group, or to specific students, as you wish. The children will need to use their fingers less frequently as their familiarity with this activity grows.

If the preceding questions caused no great difficulty you could move on to questions such as,

T: My friend Lou is four. Last year he was . . . ?

Then, later in the year you could probably combine both these sorts of questions:

T: My friend Lenny is eight. Last year he was . . . ? (Seven)

Next year he will be . . . ? (Nine)

T: That's right! 7, 8, 9!

K45

TITLE: Car Tracks #1

MATERIALS:

Teacher - Two sheets of Track Pieces, i. e., 16 curved sections and 16 straight sections

Students - Two sheets of Track Pieces for each group of four to six children

IMPORTANT NOTE:

These Track Pieces will be called for again in Lesson K57 so don't dispose of them after use. It would save time when you reach Lesson K57 if after the present lesson you store the Track Pieces in envelopes, each containing eight straight sections and eight curved sections.

DESCRIPTION OF LESSON:

Seat the children in a large circle.

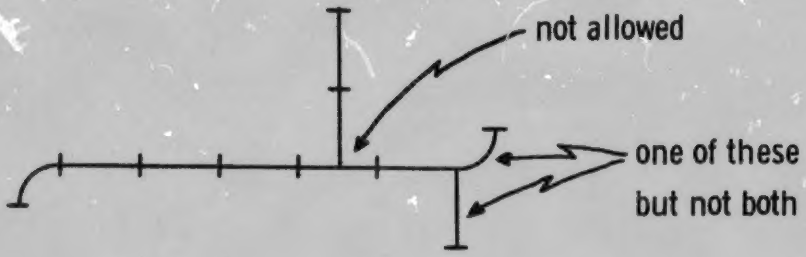
Produce your Track Pieces, already separated from each other.

T: These are called Track Pieces, and today we are going to use them to build a big car racing track together.

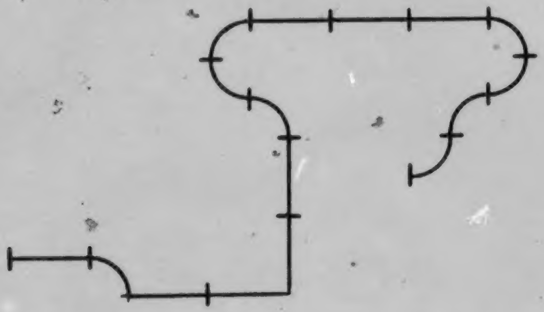
Lay down a straight section.

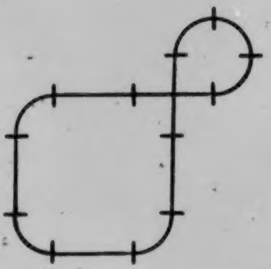
T: Who would like to continue my car track?

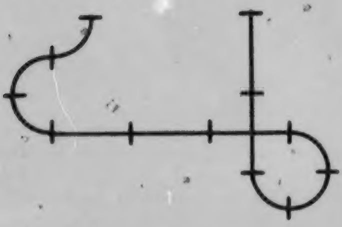
Let several children come up and add track pieces one at a time. You might have to make it clear that, at any stage in the building of a racing track, the next piece should only be added at one of the two ends of the portion of racing track already built (in other words you don't want to end up with a car racing track with "branches":)

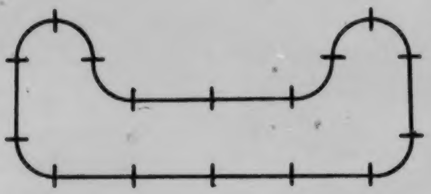

not allowed
one of these
but not both

Here are some possible racing tracks:









When either all 32 pieces have been laid down or else a circuit has been completed, divide the children into groups of four or five and assign each group a space on the floor. Give each group two sheets of Track Pieces, which they are to separate and share out among themselves.[*] This sharing need only be approximate; the children should not spend a lot of time trying to make sure that each member of the group has exactly the same number of straight sections and/or the same number of curved sections.

Each group is to build a car track, modeling their work on the procedure followed in the collective part of the lesson. The only additional rule (which you should make very clear) is that, in each group, the children are to take turns laying down their track pieces.

IMPORTANT NOTE:

> It is unlikely that any group will produce a closed circuit. If this does happen, however, be enthusiastic about it! For example, you could say:
>
> T: Look at this group's track. Their racing car can go around and around and around.

---

[*] If there aren't enough Track Pieces for all the students, you could let some students work with the ones you have been using for the collective part of this lesson.

K46

TITLE: Monkeys and Bananas

MATERIALS:

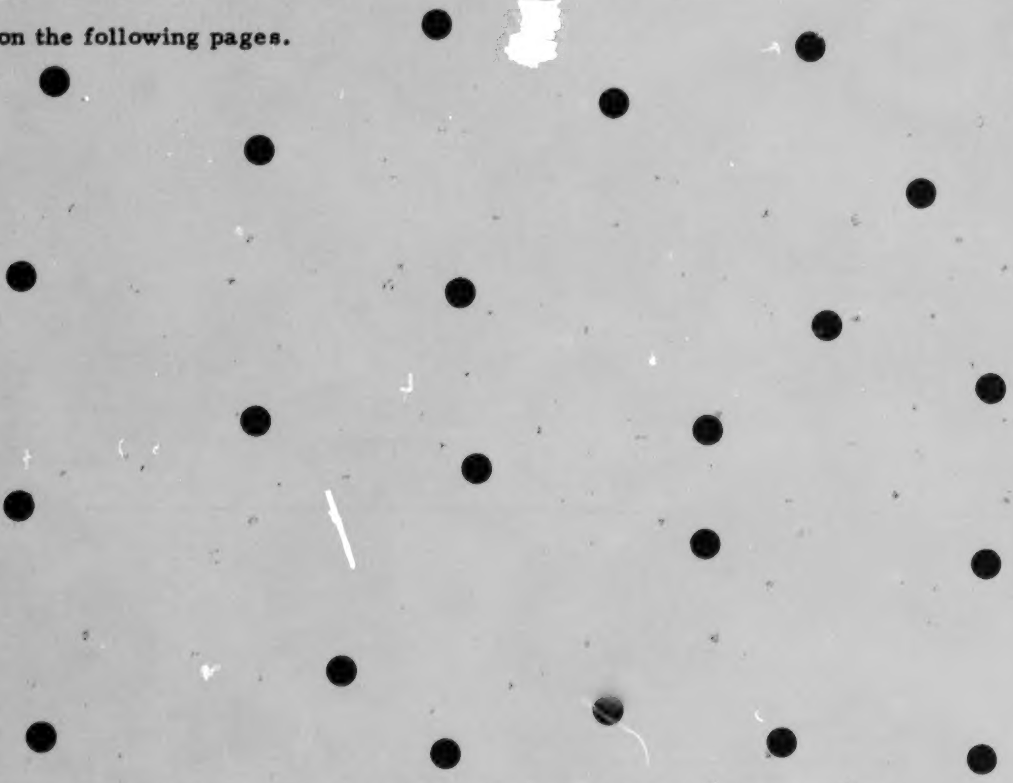
Teacher - Colored chalk*

Students - None

DESCRIPTION OF LESSON:

Start the lesson by holding a brief discussion about monkeys and what they eat.

Draw 22 dots on the board as follows. Be sure to spread them out well so that you will have sufficient room to draw arrows as indicated in the pictures on the following pages.



T: Some of these dots are for monkeys, and some are for bananas. How many dots are there? (22)

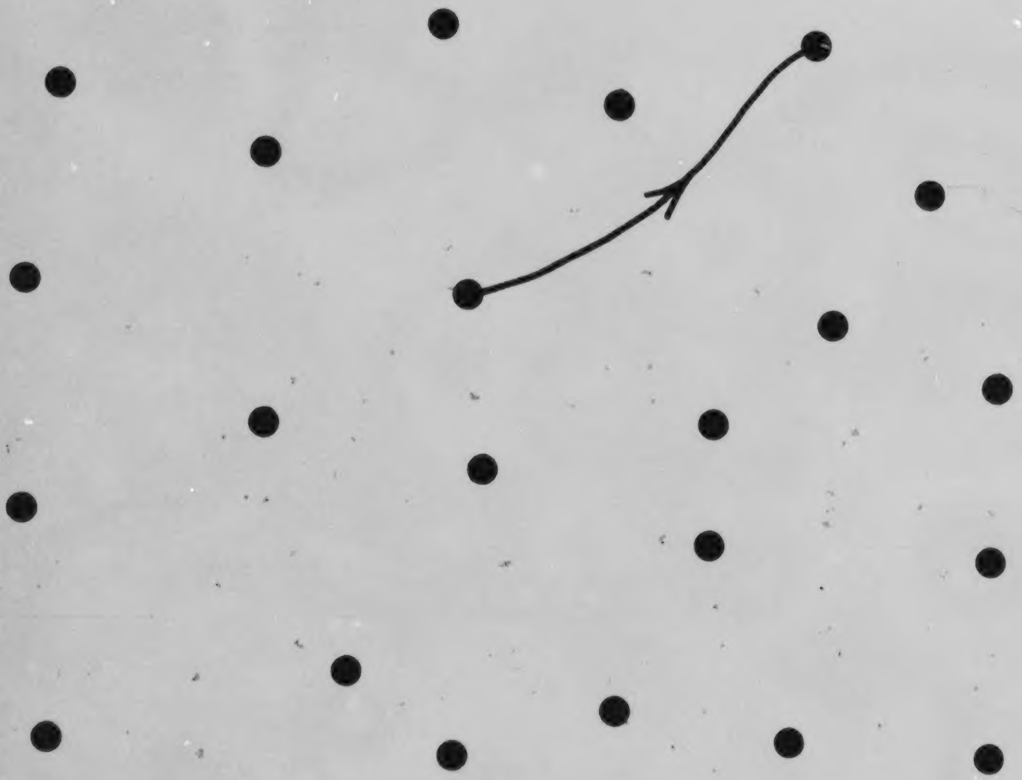
K46

Let several children count the dots out loud and point to "22" on the 0-99 Numeral Chart or in the Numeral Row.

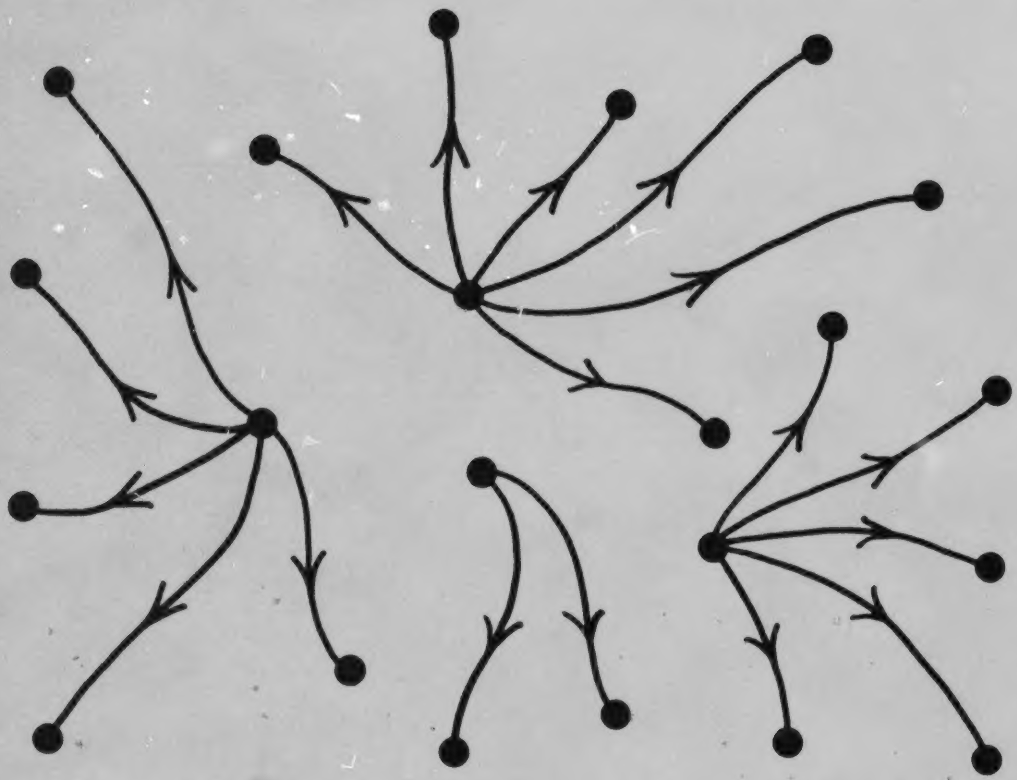
T: These monkeys are very hungry and they don't have very nice manners, so they are going to grab as many bananas as they can.

Draw one arrow as you say:

T: This monkey grabs this banana.



Ask a student to point first at the monkey and then at the banana. Tell your students to close their eyes, and, while their eyes are shut, you should complete your drawing:



Pose various problems about this arrow picture. For example,

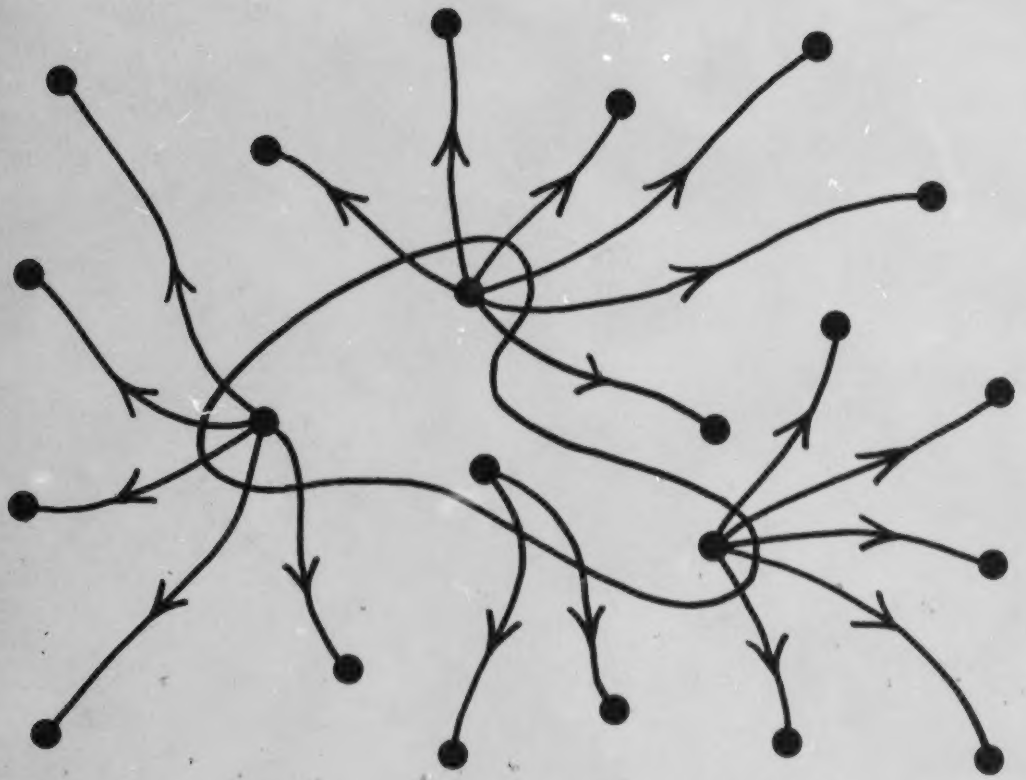
T: Point to a monkey.

Point to a banana.

(Point to a "monkey-dot.") How many bananas does this monkey grab?

Point to all the monkeys. How many of them are there? (Four)

Let someone trace a string surrounding just the four monkeys. Draw the string yourself.



T: How many bananas are there? (18)

Point to the monkey who grabbed the most bananas.

Point to the monkey who grabbed the fewest bananas.

What about the other two monkeys? (They each grabbed the same number of bananas as the other.)

(Indicate two of the monkeys.) How many bananas did these two monkeys grab between them?

TITLE: Number Readiness #6

SUGGESTED ACTIVITIES (see the introduction to Lesson K3):

A. Happy Fish

MATERIALS:

Teacher - Magnetic board* (see the note at the beginning of Lesson K6); demonstration Minicomputer checkers; colored chalk*

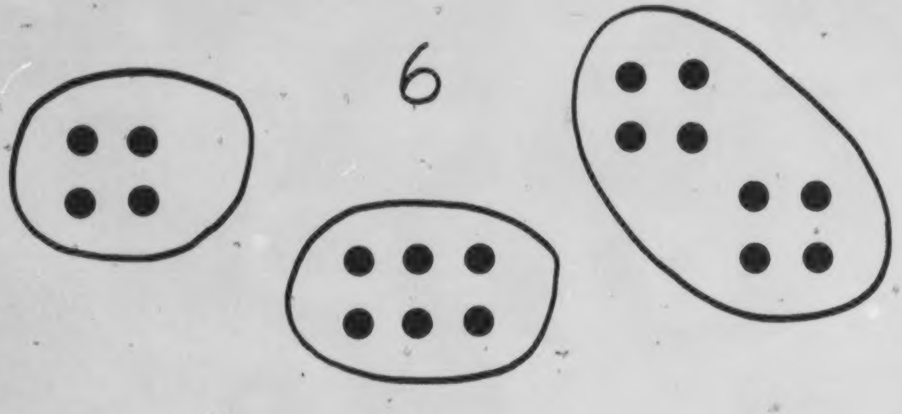
Students - None

DESCRIPTION OF ACTIVITY:

Remind the children about your friend who owns a pet store which specializes in fish, and about his niece, Jody, who loves to help look after the fish, but isn't very good at counting.

T: Well, yesterday Jody cleaned out the bowls and put the fish back in three of them like this.

Draw three strings and place magnetic checkers in them as follows:



K47

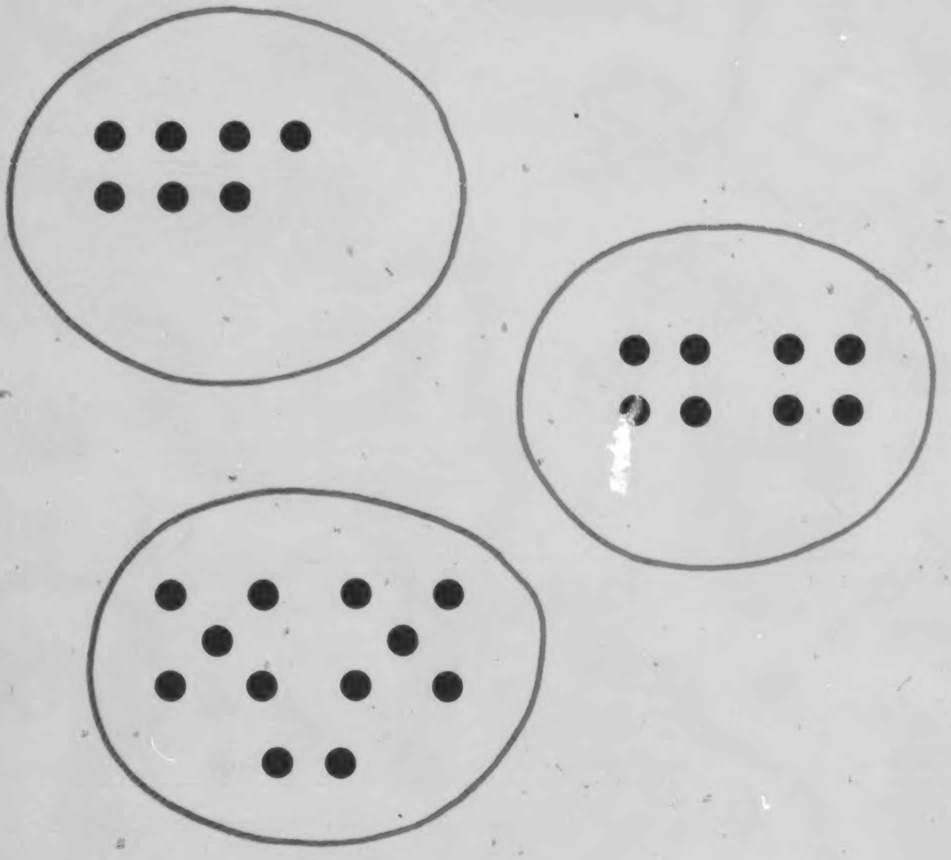
T: Each bowl is supposed to contain six fish.

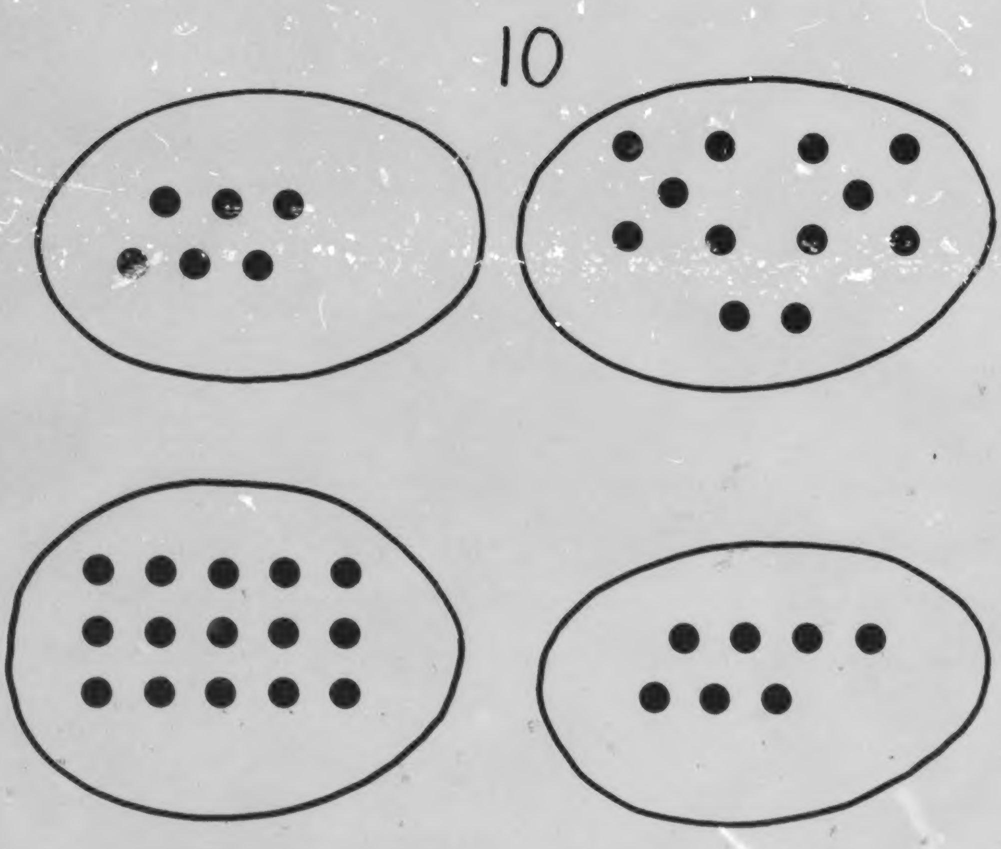
The students will probably notice that something is wrong.

Ask them to help Jody. The idea is for them to rearrange the checkers that are already on the board, so don't provide any extra checkers.

If your students enjoy this activity, here are two other problems involving larger fishbowls:

9





B. The 0-99 Numeral Chart

MATERIALS:

Teacher - 0-99 Numeral Chart

Students - None

DESCRIPTION OF ACTIVITY:

The 0-99 Numeral Chart can lead to many numeral-writing and counting activities.

We provide the following suggestions among which you could choose.

Ask a child to point to a number and read it.

Ask the class to read a given column. What do you notice? (All the numbers end with the same digit.)

Ask the class to read a given row (not the first row). What do you notice? (All the numbers start with the same digit.)

Ask a child to find the largest and the smallest numbers in the chart.

Ask the class to start at "0" and read every other number.

Ask the class to start at "1" and read every other number.

Ask the class to count backward from various places.

Ask the class to read along a given diagonal.

Ask a child to find the two numbers in the middle of a row.

Ask a child to read a number, then the one just before it, then the one just after it.

You could also arrange for a volunteer to stand next to the chart. His or her job will be to point to numbers as they are called out by other students.

This activity occurs again in Lesson K56, but you should feel free to make use of the 0-99 Numeral Chart at any time during the year.

EARLY WARNING:

Lesson K48 calls for the handprint frieze you made in Lesson K36-1; finger paint (one color); some stamps or templates (see the note in Lesson K48, Activity 2); watercolor (one color). You should collect these items together before the lesson begins.

TITLE: Mirror Symmetry #2

MATERIALS:

As in all activities involving paint, you will need some newspapers* to protect the surroundings; and both you and each of the children will need an apron* or smock* to protect yourselves. Water and paper towels will be handy.

Activity 1:

MATERIALS:

Teacher - The handprint frieze made in Lesson K36-1; finger paint* (one color)

Students - A piece of paper*

DESCRIPTION OF ACTIVITY:

Show the class the handprint frieze you made in Lesson K36-1. Let the children talk about it for a while. Then continue as follows:

T: Do any of the red hands on the picture match a left hand?

S: No.

S: Unless you turn the paper over.

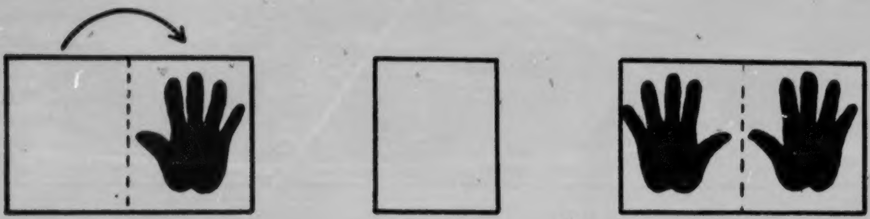
T: You are right, but I am thinking just of this side of the paper for now. Do any of the blue hands on the picture match a right hand?

S: No.

K48

Give each child a piece of paper, ask the students to fold these neatly in half, and then to unfold them again.

T: I am going to come around the room and print my right hand in red[*] on one half of your piece of paper. As soon as I have done that, fold the paper up again and press hard on it (demonstrate this if necessary). Finally, unfold your piece of paper again.



Once this has been done and everyone is looking at your double handprint,[**] ask:

T: What do you notice?

It is probably not too much to hope that some students will realize that they now have two red hands on their paper, one matching a right hand, the other one matching a left hand.

---

[*] Use the color you used for right hands in Lesson K36-1.

[**] You might want to let the pictures dry before proceeding with this activity.

Activity 2:

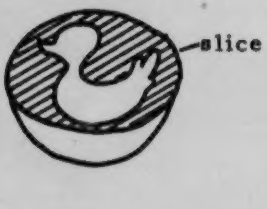
MATERIALS:

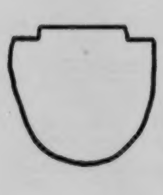
Teacher - None

Students - Several pieces of paper* for each child; stamps* and ink pads*, or templates* and watercolor* (see the note below) or finger paint*

IMPORTANT NOTE:

Stamps are probably more practical than templates for this activity. You can make a stamp by cutting a simple shape out of styrofoam (for example, you could use the thin styrofoam trays on which prepackaged meat is sold in supermarkets). Alternatively, you can make a stamp out of a potato. Cut the potato in half, carve a design on the flat surface of the cut, and then slice away the background so that the design stands out.





You could of course have only one stamp and print the picture yourself for each child, but this would be much less fun.

If you use watercolor or finger paint, it would be advisable to experiment before the lesson to find out what consistency produces the best results.

Whatever you decide to use, it is important that the designs represent something which obviously has a "front" and a "tail."

For example:

- a side-view of an animal
- a side-view of a marching person
- a side-view of a car.

DESCRIPTION OF ACTIVITY:

Distribute several pieces of paper to each child, and tell the students to fold these in half and then unfold them again.

Next, distribute the stamps and ink pads or the templates and paint. (In what follows, we suppose that you have decided to use stamps.)

T: Try the stamp out on a piece of scratch paper. What does it look like?

S: A car.

T: Now take one of the pieces of paper you folded in half. Press the stamp onto one half of the page so that the car is driving toward the door.

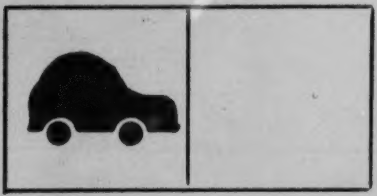


Figure I

OR

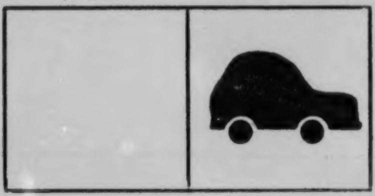


Figure II

T: Fold the paper and press hard. Don't unfold it yet. Could someone say what he or she thinks the image is going to be?

S: Another car.

T: Will it be driving toward the door?

S: Yes.

T: Let's see. Unfold your pieces of paper.

S: It's not driving toward the door.

S: It's driving away from the other car. (Figure II produces this result.)

S: My cars aren't: they are going to crash. (Figure I produces this.)

If you get two answers such as the last two, ask the students concerned to show their papers to the rest of the class, not forgetting to indicate which was their first car.

Repeat this activity once or twice with some different stamps.

The last time you do it, try to introduce the idea that you would like both the resulting designs (the original print and its image) to be facing away from the fold-line, or that you would like them both to be facing toward the fold-line.

Activity 3: (Optional) Butterflies.

MATERIALS:

Teacher - None

Students - Several pieces of paper* for each child; watercolors*

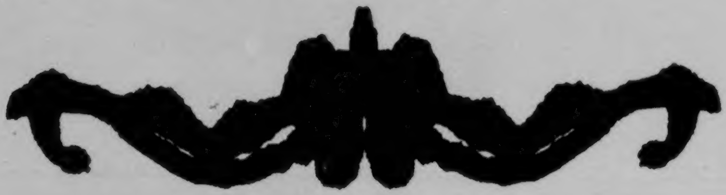
K48

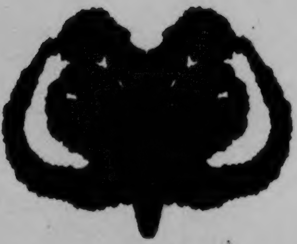
DESCRIPTION OF ACTIVITY:

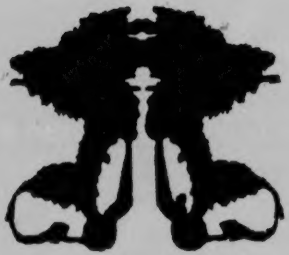
This is a suggestion for an art activity; you could easily do it on some other day. It is an activity with which most kindergarten teachers are familiar.

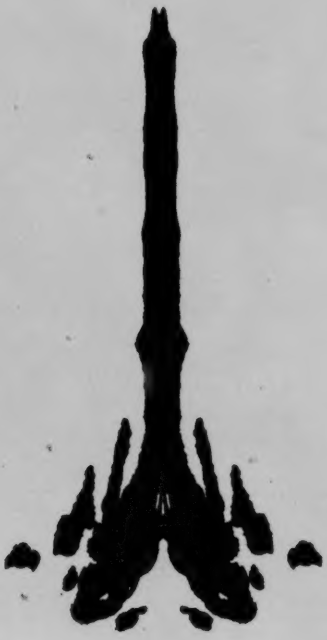
The children fold their piece of paper in half, unfold it again, dab a splotch of watercolor on one half of the page, fold the paper again, and press hard on it.

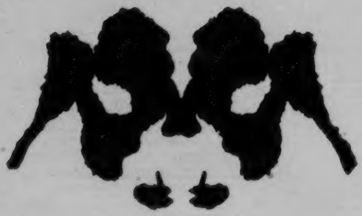
The result is a design which has very striking symmetry.











TITLE: Clowns

MATERIALS:

Teacher - Colored chalk*

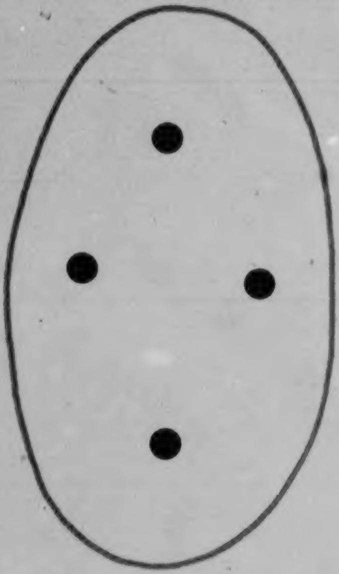
Students - (Optional) paper*; colored pens,* pencils,* or crayons*

DESCRIPTION OF LESSON:

T: Today we're going to tell a circus story.

In this string there are some clowns.

Draw the following on the board:



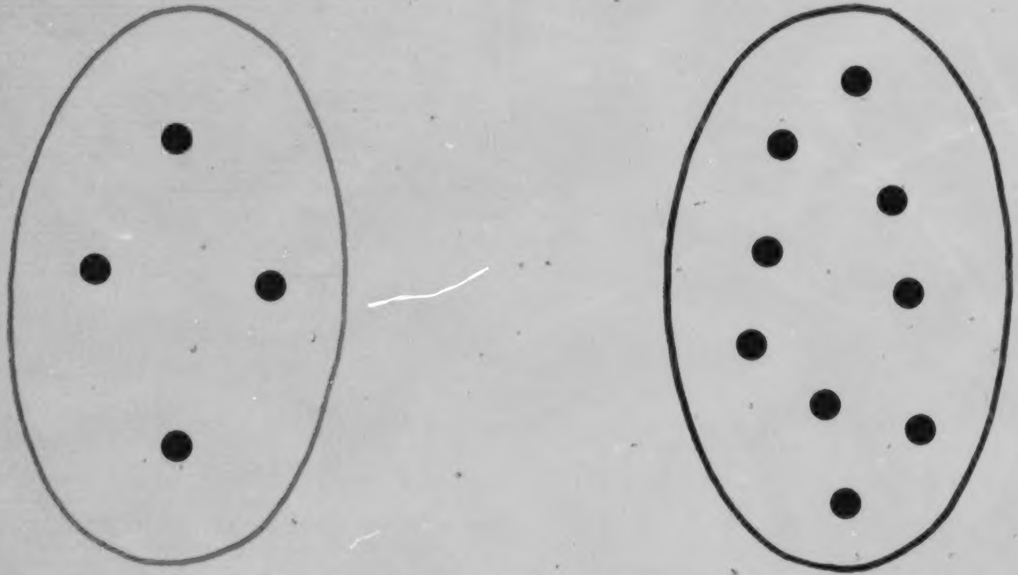
T: How many clowns are there?

S: Four.

T: Right. There are four clowns, and they are supposed to be juggling some dishes. Here are the dishes.

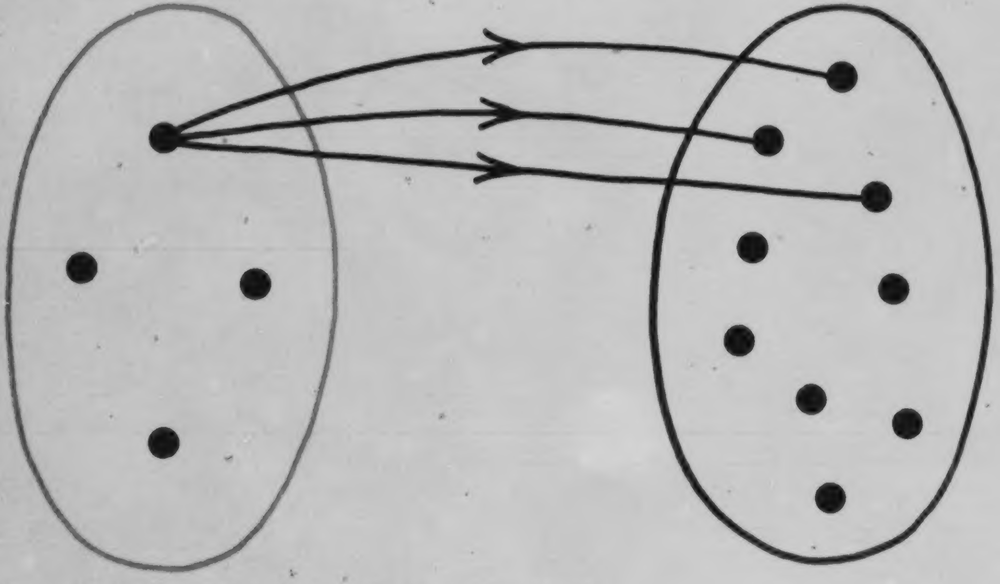
K49

Continue your drawing at the board:



T: How many dishes are there? (Nine) These are the dishes the clowns are juggling.

Draw the following three arrows:



T: How many dishes is this clown juggling?

S: Three.

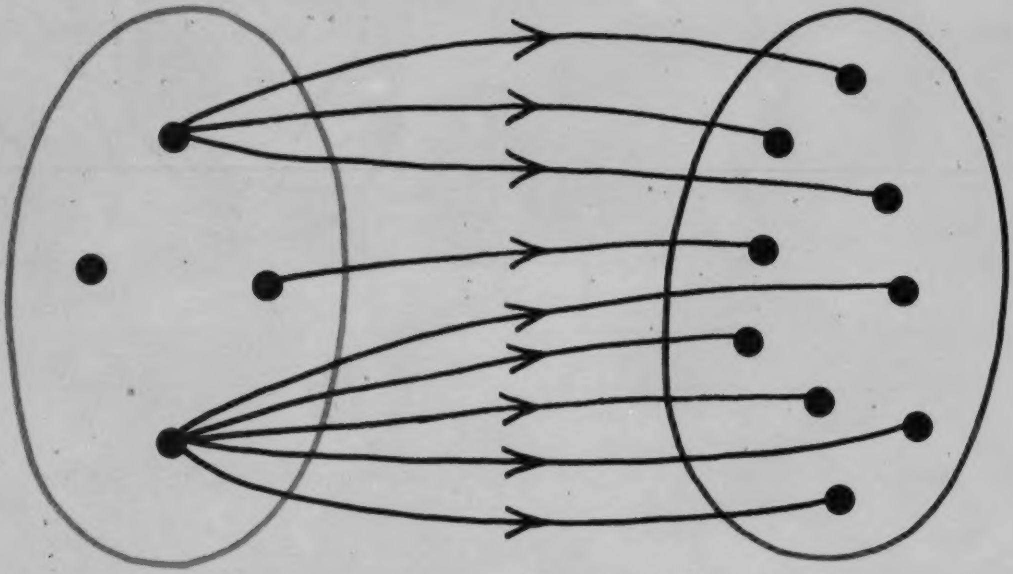
T: How many clowns are not performing yet?

S: Three.

T: How many dishes are left?

S: Six.

Complete your drawing:



Ask various questions such as:

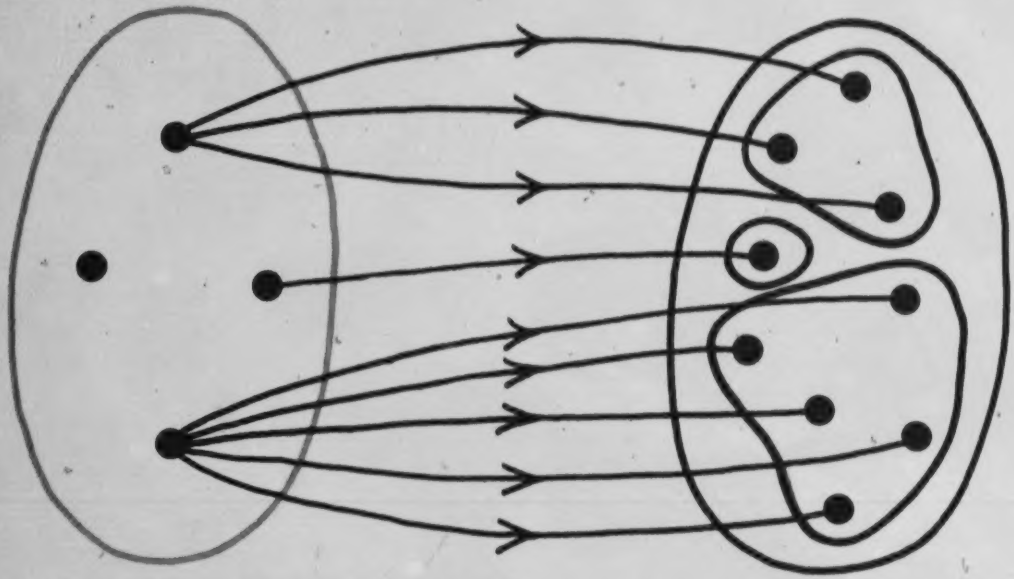
T: Which clown is juggling the most dishes?

How many dishes is he or she juggling? (Five)

How many dishes is this other clown (point to one of the other two jugglers) juggling?

What do you think about this clown (the one with no dishes)?

Let children come up and, for each clown, trace a string around all the dishes he is juggling. Draw each string yourself. Your final drawing will look like the following:



OPTIONAL CONTINUATION OF LESSON:

Distribute paper and colored pens, pencils or crayons.

T: I would like each of you to draw a clown and dishes story. In your story, you should have three clowns. So draw three big, beautiful dots for the three clowns.

Then draw a string around them.

Now draw a string for the dishes. Draw dots for the dishes inside that string; you can have as many dishes as you like.

With a colored pen (pencil or crayon), show how the clowns are juggling the dishes.

This is probably the first arrow picture your students have ever drawn. So don't be surprised if the arrows look clumsy, if they go in the wrong direction, or if the arrowheads are missing altogether. Accept these first attempts, however they might look.

Make a point of walking around the room, giving each child a chance to talk about his or her story.

K50

TITLE: Guess My Number #1

MATERIALS:

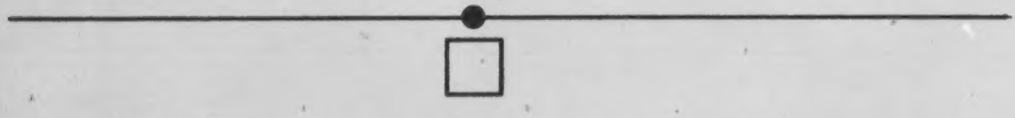
Teacher - A Number Line (if you don't have one permanently mounted in your classroom you should draw one on the board at the appropriate moment)

Students - None

DESCRIPTION OF LESSON:

Activity 1:

Draw a fairly long line segment on the board; add a large dot with a box under it approximately in the middle of the segment.



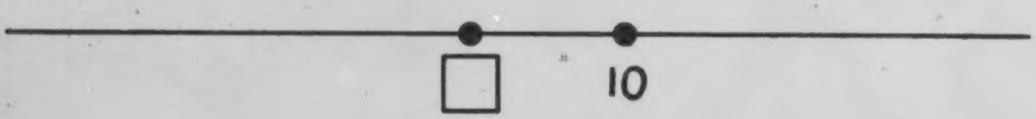
T: I have a secret number which I have hidden in this box. Can you guess my number?

(To add to the fun, you might like to have the number written on a small, folded-up piece of paper. Let's suppose your number is 8.)

S: 10.

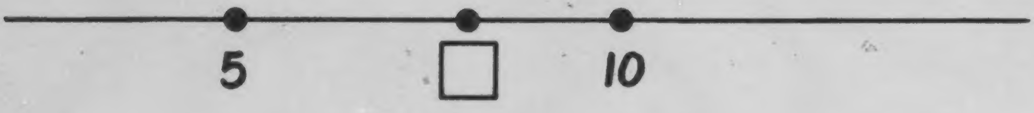
T: My secret number is smaller than 10.

Add a dot for 10 to your drawing.



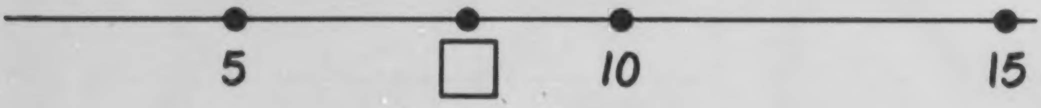
S: 5.

T: My number is larger than 5.



S: 15.

Before saying anything, draw a dot for 15.

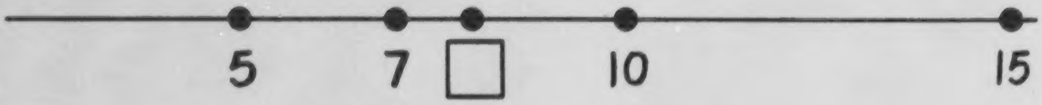


T: What do you think? Is my number smaller or larger than 15? (Smaller)

S: 7.

T: That's a very close guess, but my number is larger than 7.

Draw a dot for 7.



S: 8.

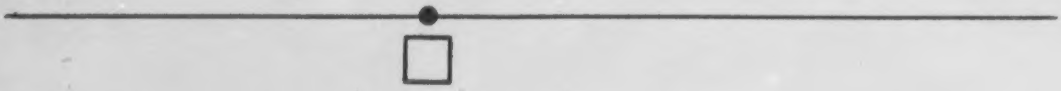
T: You've found it.

If at the beginning of the lesson you wrote the number on a piece of paper, give the paper to the student who guessed the number correctly and let him or her unfold it. Then write "8" in the box.

Activity 2:

T: Now I have another secret number. I have hidden it in this box.

Draw the following on the board:



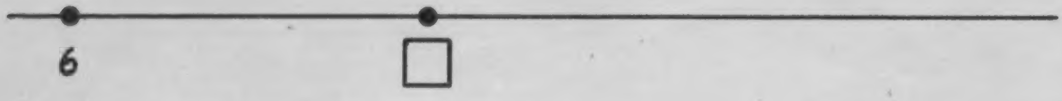
Once again you could write your number on a piece of paper. Let's suppose you choose 23.**

T: Can you guess my number?

S: 6.

T: My number is larger than 6.

Draw a dot for 6.

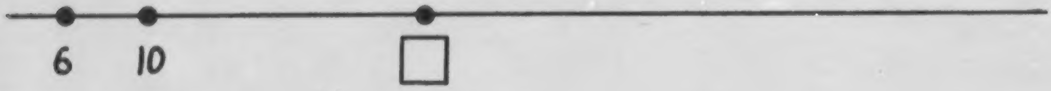


Your drawing should indicate that your number is much larger than 6.

S: 10.

T: My number is larger than 10.

Draw a dot for 10.



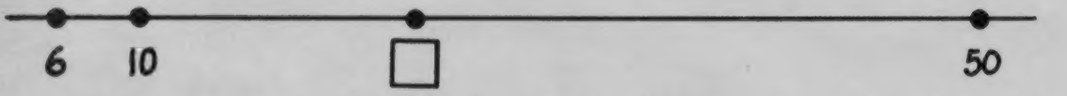
** Adjust your choice of numbers to the numerical ability of your students.

K50

S: 50.

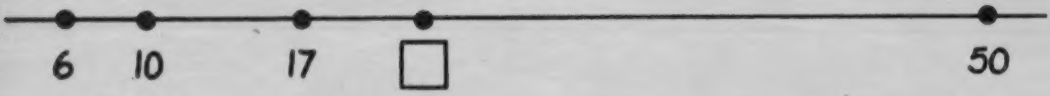
T: My number is smaller than 50.

Draw a dot for 50.



S: 17.

Draw a dot for 17.



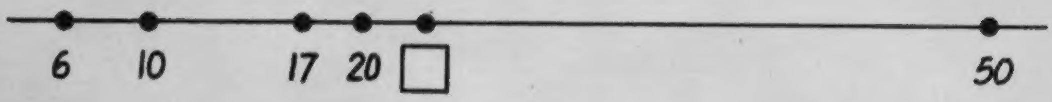
T: Look at the picture. Is my number smaller or larger than 17?

S: Larger.

S: Is your number larger than 20?

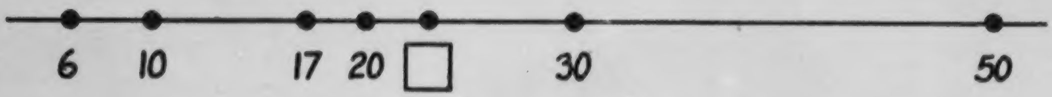
T: Yes.

Draw a dot for 20.



S: 30.

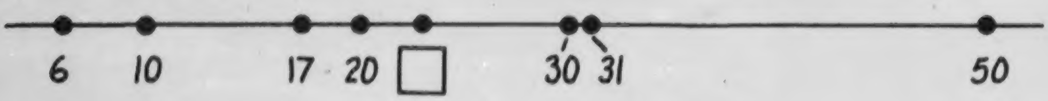
T: My number is smaller than 30.


6
10
17
20
☐
30
50

S: 31.

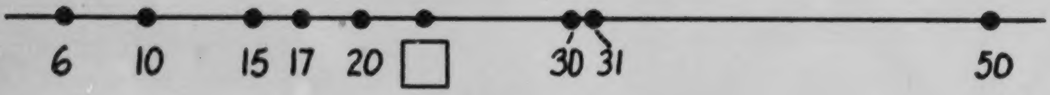
T: My number is smaller than 31.

Draw a dot for 31.


6
10
17
20
☐
30
31
50

S: 15.

Draw a dot for 15.



"Wild guesses" such as the last two are often made when the game is taking quite a long time. If such guesses occur,[*] ask your class to look very carefully at the picture for a little while, and then ask:

T: What are the best two guesses so far?

S: 20 and 30.

T: Right, we know that my secret number is somewhere between 20 and 30.

T: Look at the Number Line.[**]

Can someone point to 20?

Can someone point to 30?

My number is between 20 and 30. What could it be?

S: 21 or 22 or ... or 29.

To help your students answer this last question, you could hold one piece of paper so that it covers 20 and some of the numbers immediately to the left of 20, and another piece of paper so that it covers 30 and some of the numbers immediately to the right of 30, as shown in the following drawing:

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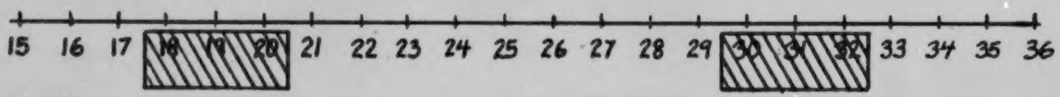
[*] If no wild guesses are made, and your number is found without difficulty, don't bother with the questions that follow.

[**] Not the one you have just been drawing; the one which you have permanently mounted somewhere in your classroom.


15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
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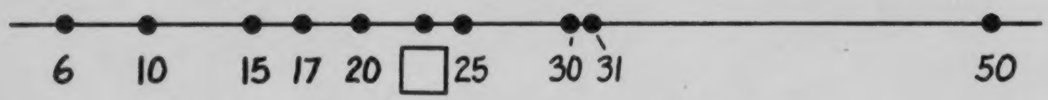
31
32
33
34
35
36

S: Is your number 25?

Draw a dot for 25.


6
10
15
17
20
25
30
31
50

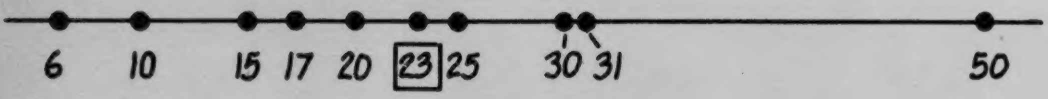
T: That's a very good guess. Is my number larger or smaller than 25?

S: Smaller.

S: Is your number 23?

T: Yes.

Write "23" inside the box:



S: I found it!

If you previously wrote the number on a piece of paper give the paper to the student who found the number and let him or her unfold it.

NOTE:

This game is usually a big "hit" with Kindergarten children. It is scheduled again in Lesson K68. However, your students will probably ask if they can play it more frequently. Feel free to do this.

EARLY WARNING:

For Lesson K51 you will need a square grid (see the note in Lesson K27). If you decide to take Option II in Lesson K51, you will need some grid paper for your students (see the note in the lesson).

TITLE: Taxi-Geometry #3

MATERIALS:

Teacher - Square grid* (see the note in Lesson K27); colored chalk*

Students - (Optional) grid paper;* colored pens,* pencils,* or crayons*

IMPORTANT NOTE:

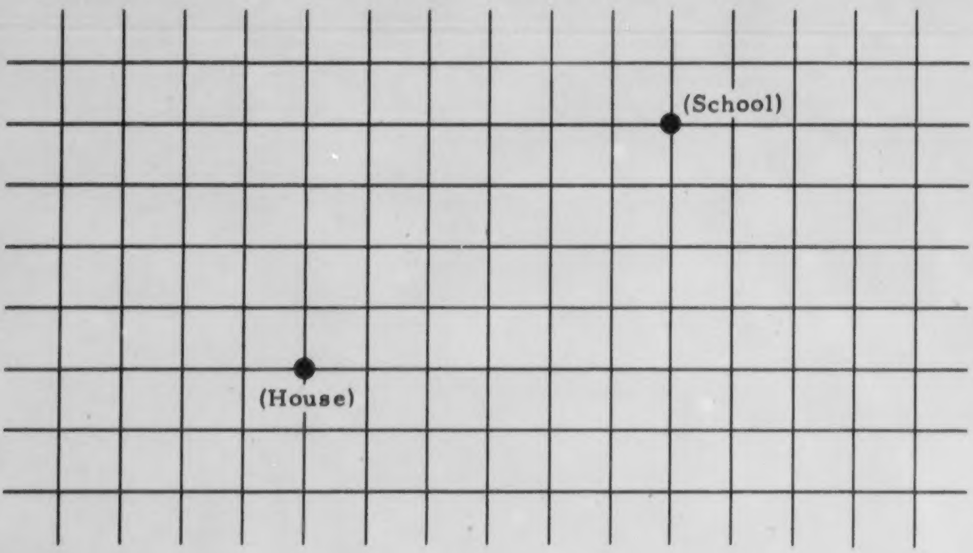
The grid paper you give to your children should have fairly large squares, say approximately 2cm x 2 cm.

DESCRIPTION OF LESSON:

Display the square grid and ask whether anyone remembers the story about Nick. Once again, make sure that everyone remembers Nick has to follow the streets.

Draw one dot for Nick's school and another for Nick's house (each on an intersection).

Don't write the words "house" or "school" on your drawing.



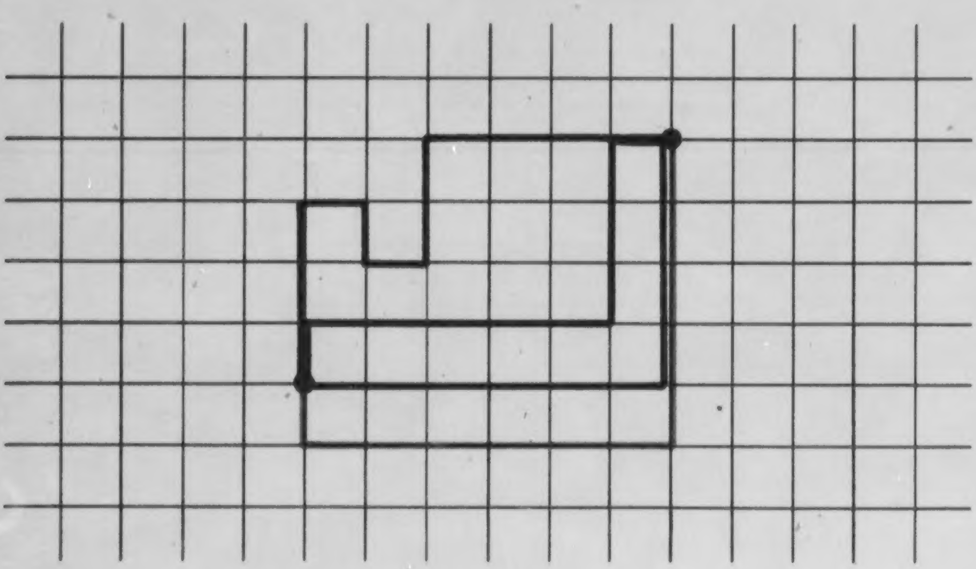
T: This morning Nick got up really early. The sun was shining brightly, so he decided to take a long walk to school.

Let two or three children come to the board and trace some long walks Nick could take from his home to school. Do not draw them, however.

T: Nick's mother told him to get home as quickly as possible this evening. So on his way home he will have to find a very short route.

Let some children come to the board and trace very short ways Nick could come home from school. Draw each one of these suggestions (even if some of them are not shortest ways).

For example, your grid might end up looking like this:

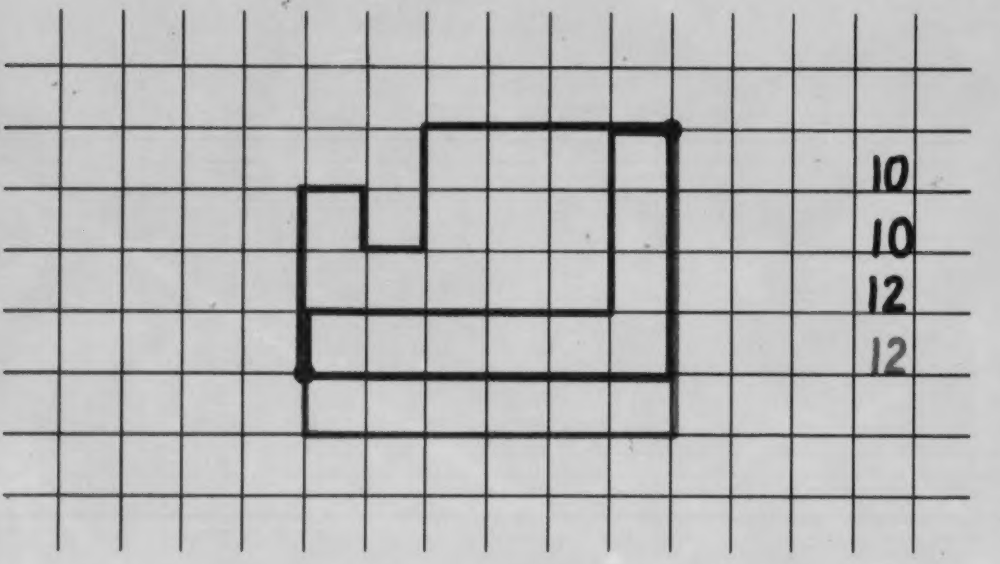


T: Which way do you think is the shortest?

Probably not everybody will agree on an answer.

T: To find out for sure, let's measure them. Remember, this is one block.

Record this unit ("├┴┤") on your picture, and let some children come to the board and count how many blocks long each way is.* Record each length in the appropriate color, as shown in the following picture:



The students will probably agree that the black path and the red path are the shortest ones.

T: What if Nick came home by the blue route?

S: His mother would be upset.

S: He would be going out of his way.

---

* See the note at the end of Lesson K39 for details of how to avoid some of the most common block-counting mistakes.

T: Right. Can you show us where he would be going out of his way?

Let a student come to the board and show this.

T: When you go out of your way, we say that you're "making a detour."

Did Nick make a detour in the yellow path?

Let someone come to the board and indicate where the detour occurred.

If your children are still interested you could continue with one of the following activities.

OPTION I:

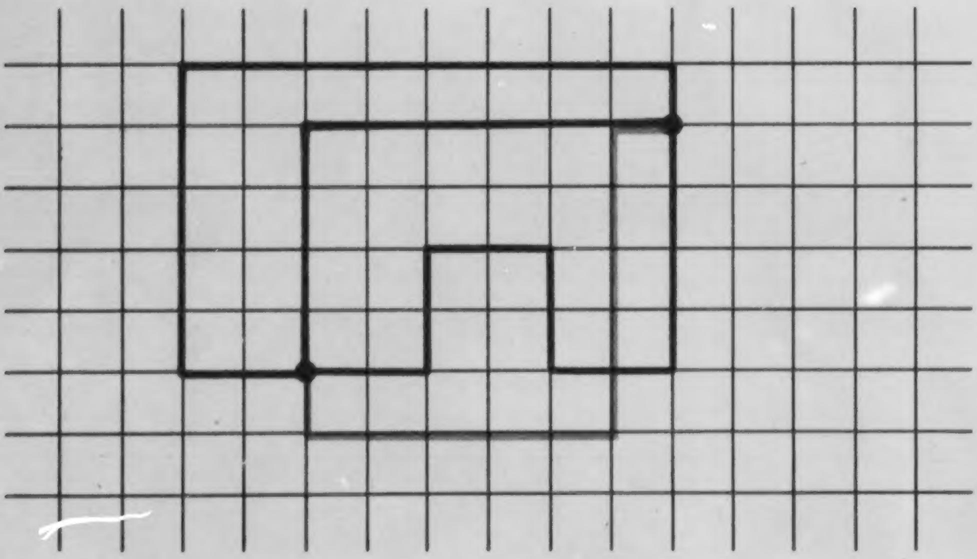
Erase all the paths that are drawn on the board. Leave the dots for Nick's house and his school.

Tell the students that you are going to trace (with a pointer) some ways that Nick could come home from school.

If they think it is the shortest way, the students should clap.

As soon as they think Nick is making a detour, the students should raise both hands in a sign of protest.

The first path you trace (not draw) should be one with a very obvious detour; for example, the red path in the following drawing:



Answers for the above picture:

red path: detour - children raise both hands.

black path: detour - children raise both hands.

blue path: no detour - children clap.

yellow path; detour - children raise both hands.

OPTION II:

Distribute grid paper and colored pens (pencils or crayons) to the children. Tell them to draw one dot for Nick's house, and another for his school. Both dots should be on a street corner (intersection). If necessary, give individual children some help in locating these dots.

Then tell the students to draw

one long path

and

two paths which are as short as possible between Nick's house and his school, using a different color for each path.

Students who finish quickly could be encouraged to count how many blocks long each of their short paths is. Of course, answers will vary from one student to another, since they will probably have positioned their original two dots differently.

EARLY WARNING:

Lesson K52 calls for some paper hats (see the lesson for details).

TITLE: Permutations #1

MATERIALS:

Teacher - Colored chalk;* four paper hats*

Students - None

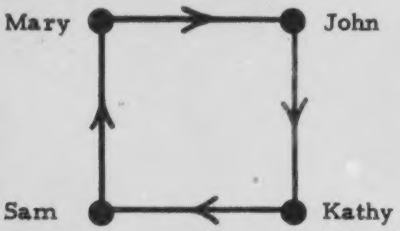
DESCRIPTION OF LESSON:

Call on four students (say, Mary, John, Kathy and Sam) and give them each a paper hat. It would be preferable if each of the hats were distinctive in some way. If this is impossible, however, write the first initial of each child on his or her hat. This is so that the other students will be more likely to notice when any of the four children have their own hats back. Ask the four children to stand in a square:

Mary
John
Sam
Kathy

T: When I clap my hands, I want you to swap hats: Mary is to give hers to John, John to Kathy, Kathy to Sam, Sam to Mary.

As you speak, draw the following four arrows:



K52

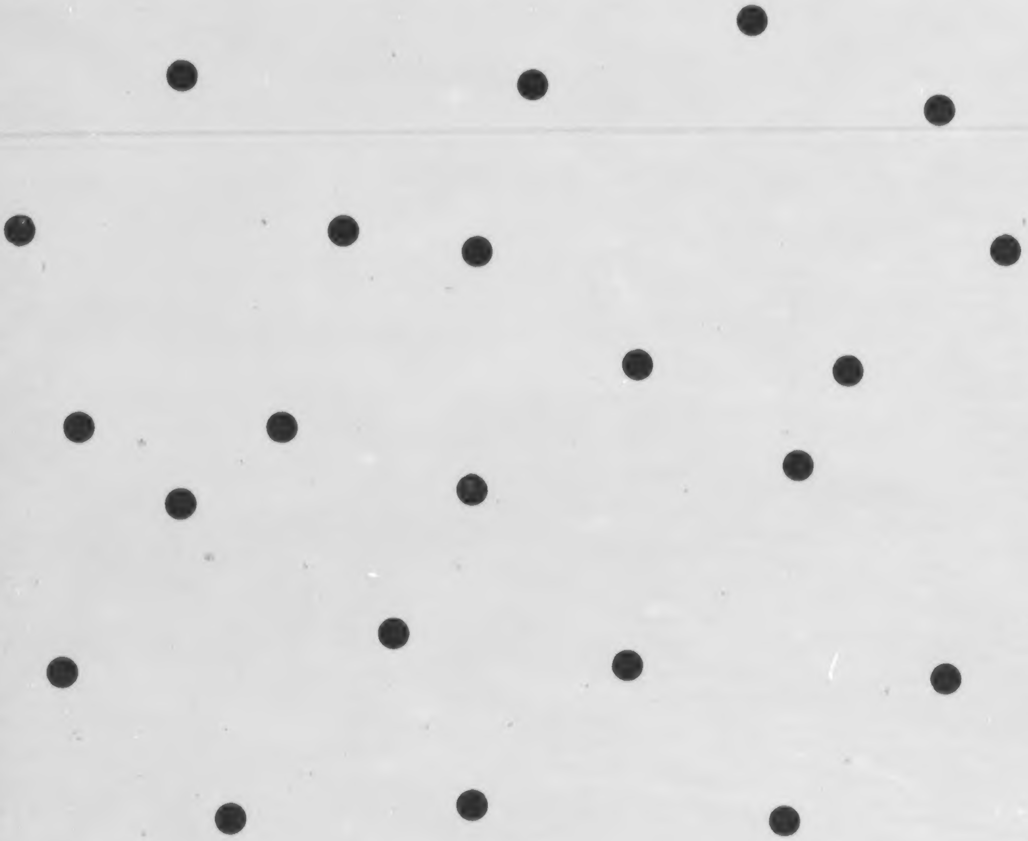
Clap your hands. Make sure the children exchange hats as prescribed by the arrow diagram.

T: Let's do that again. (Clap your hands a second time.) And once more. And once more.

T: Do you notice anything?

S: Everyone has got his original hat back!

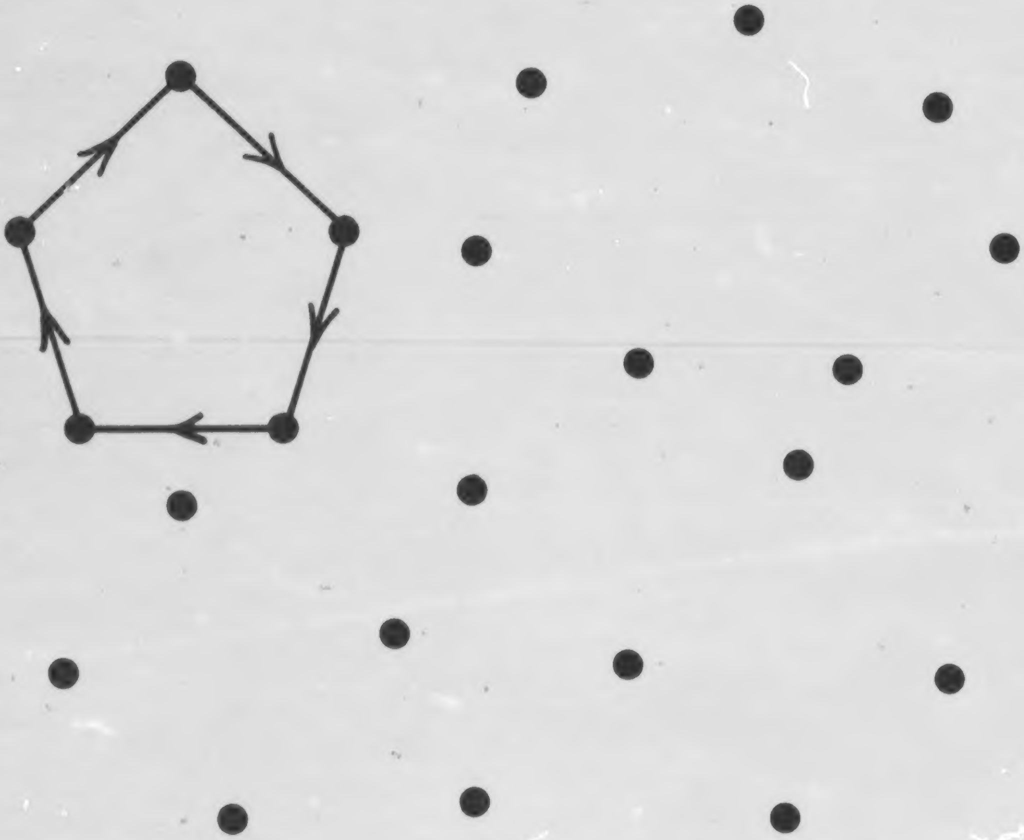
Let the four volunteers return to their seats, then draw 22 dots as follows:



Ask the children to count the dots as you are drawing them.

T: These dots are for children. Each child is wearing a paper hat. They are doing exactly what we did just now: they are swapping hats.

As you say this, draw the following five arrows:



Point to one of the five dots connected by arrows, and ask

T: To whom is this child supposed to give his or her hat?

Let a child come to the board and indicate the answer by pointing to a dot.

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Point to another of these five dots.

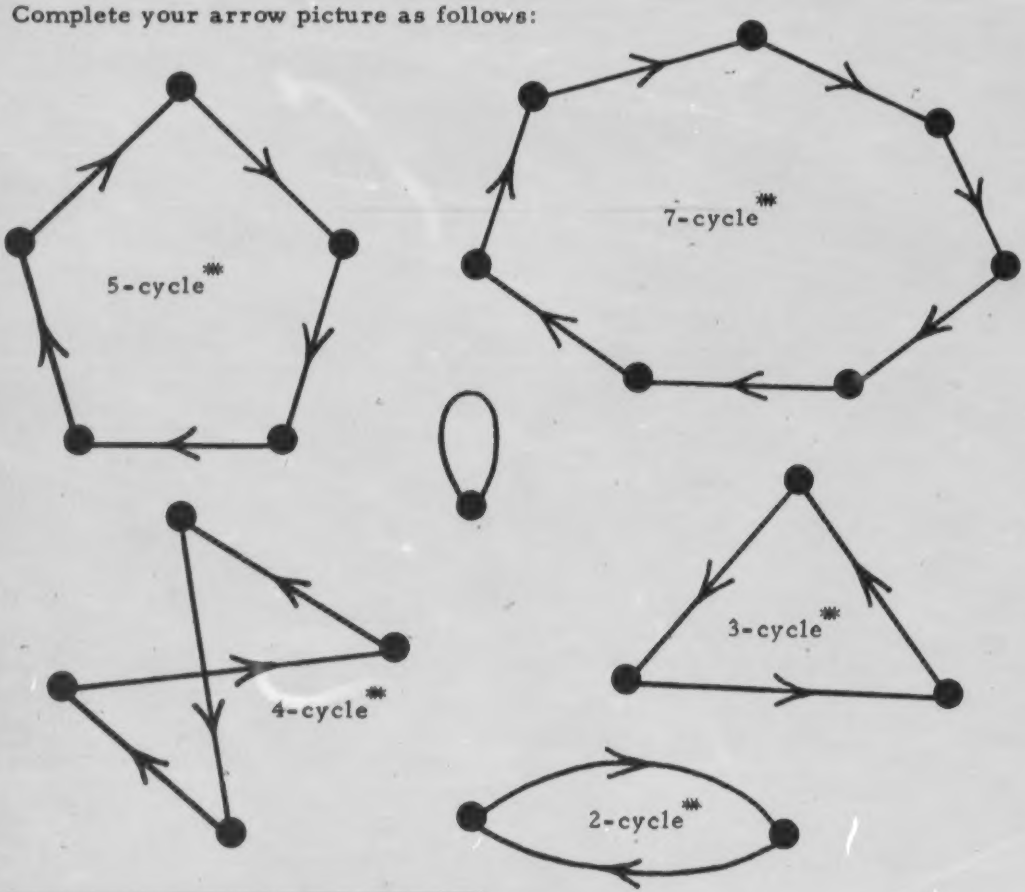
T: Who is supposed to give a hat to this child?

Let another child indicate the answer by pointing to a dot.

T: How many children are swapping hats so far?

S: Five.

Complete your arrow picture as follows:


7-cycle*
5-cycle*
3-cycle*
4-cycle*
2-cycle*

---

* Don't copy these words onto the board. They are for reference only.

Point to the 3-cycle.

T: How many children are swapping hats here? (Three) Let's play the game just like them.

Choose three children to come to the front and do this.

Proceed similarly for the 2-cycle.

Point to the loop.

T: What do you think about this child?

S: He is all by himself.

S: He keeps hold of his own hat all the time.

If your class is still interested, and you still have some time left, continue as follows:

T: Suppose these children swap hats three times in a row.

Point to a dot in the 7-cycle.

T: Where will this child's original hat be after three swaps?

Let a student trace along the three consecutive arrows.

Proceed similarly for a dot in the 2-cycle. (Trace one arrow, then the return arrow, and finally the first arrow again.)

Proceed similarly for a dot in the 3-cycle.

T: What happened?

S: That child got his or her original hat back again.

T: Are there any other children who will get their original hat back after three swaps? (Yes: the other two children in the 3-cycle, and, of course, the child represented by the dot with the loop. If necessary, you should draw your students' attention to this last child.)

EARLY WARNING:

Lesson K54 calls for a large knife and several solids which can be cut. Various suggestions as to how you can obtain such solids are given in a note at the beginning of the lesson (one of the suggestions involves making some "long-life" gelatine). In order to give yourself time to prepare these solids before the lesson, it would be advisable for you to read that note right away.

TITLE: My Number Book

MATERIALS:

Teacher - A stapler*; (optional) demonstration multicolor numeral cards (these are packaged with your demonstration numeral cards)

Students - A lot of paper;* colored pens,* pencils,* or crayons*

DESCRIPTION OF LESSON:

This is an enjoyable way of giving your students practice in writing numerals. Make sure that either the class number line or the Numeral Row is easily visible to all of your students. If you plan to use them, also make sure that the demonstration multicolor numeral cards are handy. Give each child a stack of paper which has been folded in half and stapled together to form a book.

Give the following instructions slowly and clearly:

T: Open the book to the first page.
On that page make a beautiful big "1."
On the opposite page, draw one of something. For example, you could draw one child or one house or one animal ... Whatever you like, but only one.

When everyone has finished doing this, continue as follows:

T: Now, turn to the next page. On that page, make a big, beautiful "2."
On the opposite page, draw two of something.

And so on. As soon as the children understand what is expected from them, let them work at their own pace, so that you can concentrate on the slower students.

HOW TO HELP WHEN A CHILD CANNOT WRITE A NUMERAL.

1. Ask if he or she can point to the numeral in question in the Numeral Row.
2. Write the numeral on a piece of paper and let the child trace over it with his or her finger.
3. Encourage the child to try to write the numeral in his or her book. (NEVER guide the child's hand!)

Try to discourage the children from seeing who can go the fastest or reach the largest number!

HOW TO DEAL WITH REVERSALS.

Reversals are quite common at this early age, so don't make a big fuss over them! You should, however, take any opportunity that presents itself to point the matter out lightly, saying, for instance:

T: I can see that this is a "5," and you've drawn five beautiful flowers over there. Usually, though, "5's" look the other way, like this. (Write a "5" on a piece of paper.) Would you try to make one for me that looks just like mine. You can use this to help you if you like. (Hand the child the appropriate demonstration multicolor numeral card.)

For some additional suggestions as to how to help those children who are having difficulty writing numerals you are referred to the following part of Section Four of this guide:

S1 Numeral-Writing.

Before the lesson ends you could let the children decorate the covers of their books.

If they can write already, you could ask them also to invent a title and write it on the cover.

K54

TITLE: Solids #3

MATERIALS:

Teacher - Non-hollow solids* that can be cut (see the note below - these may require to be prepared before the lesson); a large bread-knife* or electric carving knife*

Students - None

IMPORTANT NOTE:

The goal of this lesson is to provide your children with some experience of what various cross-sections of different solids look like. You will therefore need to have available solids that are non-hollow and which can be cut. Suitable styrofoam solids can probably be obtained from commercial suppliers.

The following recipe, however, will enable you to obtain equally satisfactory results much less expensively, while at the same time providing your children with a great deal of pleasure! There are of course other ways to solve this problem; one being to use Play-doh.

"LONG-LIFE" GELATINE

For 4 cups:

4 envelopes of unflavored gelatine

3 packages (3 oz. each) flavored gelatine

4 cups boiling water.

Combine flavored and unflavored gelatine; add boiling water and stir until dissolved. Pour into appropriate, pre-greased molds. Chill until firm. Unmold.

This gelatine will hold its shape for several hours, can be cut, manipulated, ... and eaten!

The following are suitable as molds:[*] cans, regular jello molds, plastic demonstration solids such as might be found in your school's mathematics laboratory. You should aim to end up with:

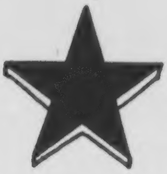
2 cylinders

3 cones — If you cannot obtain any demonstration plastic cones, you could use ice cream cones lined with waxed paper.

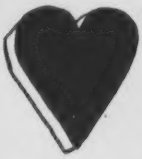
2 cubes

1 large (or 2 smaller) rectangular "bricks"

1 heart-shaped or star-shaped solid whose sides are perpendicular to the bottom:



OR



---

[*] Alternatively, you could let the gelatine set in more or less any container and then cut out the solids that you want using suitable cookie cutters.

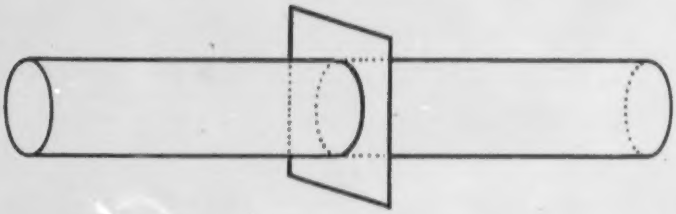
2 spheres	You may find it difficult to make a gelatine sphere; an acceptable alternative is to use carefully chosen navel oranges. If you have a solid rubber ball that you don't need to use again, that would do beautifully too!

DESCRIPTION OF LESSON:

Show one of the cylinders to the class. Ask whether anyone remembers what this solid is called. If no one does, gently remind everyone of its name.

T: I am going to cut this cylinder like this.

Don't make the cut yet; just indicate your intention with your knife.



S: You'll have two pieces.

T: Right. I'm going to cut the cylinder in two right across the middle. What shape do you think we will see when we look at the cut end of one of the pieces? (A circle[*])

---

[*] Since this question leaves it open as to what aspect of the cut end you're talking about, it could be interpreted in such a way that the correct answer should strictly be "a disk." However, this is neither the time nor the place to make such distinctions with your children. It is most unlikely that it would serve any purpose to introduce the word "disk" at this stage.

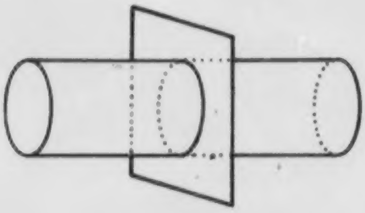
Let the children predict what shape they think the cross-section will be. They can answer in words or by drawing in the air or on a surface with their fingers. Don't indicate whether these predictions are right or wrong.

Once everyone has had a chance to make a prediction, cut the cylinder and show the cut end of one of the pieces to your students.

T: You were right: I did get two pieces, and the cut end of each piece looks like a circle. Now I have two solids. What does each of these two solids look like?

S: A cylinder.

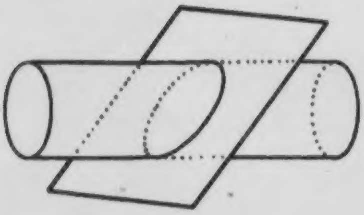
T: Suppose I cut one of these two cylinders into two pieces in the same way again. What shape would we see when we looked at the cut end of one of the pieces? (Another circle, of course.)



Once again, before you make the cut, let the children make predictions. Then, after the cut has been made, and the predictions checked, take the other half of the original cylinder.

T: Now I'm going to cut this cylinder into two pieces like this.

Indicate your intention with your knife.

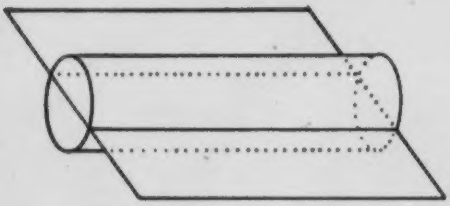


T: What shape do you think we will see when we look at the cut end of one of the pieces? (An ellipse)

Proceed as before, letting the children predict, making the cut, and checking the predictions. Some children might remark that the cut end is the same shape as one of the K - A blocks, in which case you could produce a K - A block ellipse and compare.

By now, your first cylinder is fairly chopped to pieces! Produce the second one.

T: This time I'm going to cut the cylinder into two pieces in this way.



What shape do you think we will see when we look at where the knife has cut? (A rectangle)

Do you think that each of the two pieces will be a cylinder, as they were just now? (No; neither of the two resulting solids will be a cylinder.)

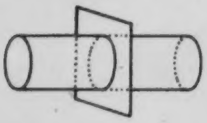
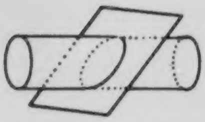
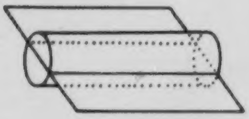
Before you find out the answers to these questions by actually making the cut, let the children predict what will happen. Check the predictions once the cut has been made.

Proceed in a similar fashion to the above for the other solids.

In some cases you might get some very strange predictions. Don't worry: this kind of experience is almost certainly new for most of your students. What is important is that they get the opportunity to think about what the cross-section is going to look like, and then to check their predictions.

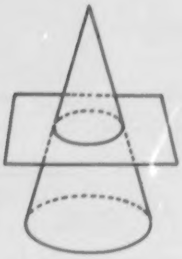
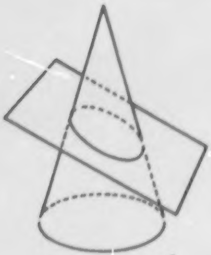
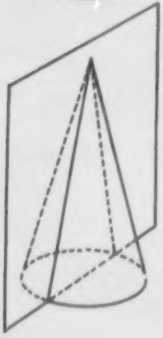
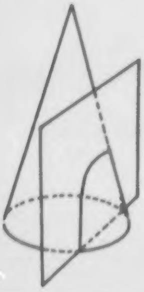
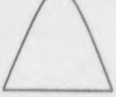
Suggestions as to which ways you might cut the various solids (together with descriptions of the cross-sections obtained) are given below. Don't feel obliged to try every single cut! Make your choices according to the ability and interest of your students ... and, of course, according to which solids you were able to obtain.

Cylinder:

How to cut	Shape of cross-section	
	circle	In order not to have to make three cylinders we suggest that you use one of the "small" cylinders obtained from the previous cut.
	ellipse	
	rectangle	

K54

Cone:

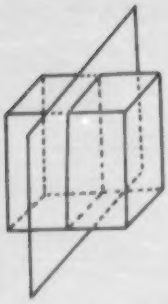
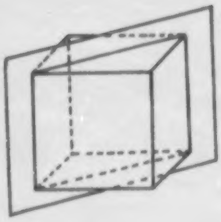
How to cut	Shape of cross-section
	circle
	ellipse
	triangle
	 *

In order not to have to make four cones we suggest that you use the "small" cone (i. e., the upper part) obtained from the previous cut.

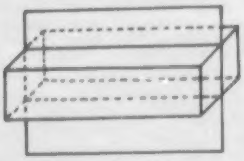
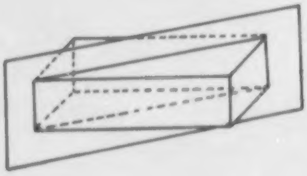
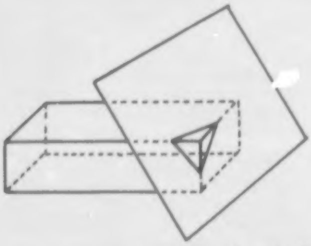
---

* Children usually guess that this cross-section will be shaped like a triangle. If someone disagrees with the rest of the class, let him or her go to the board and draw the shape he or she has in mind.

Cube:

How to cut	Shape of cross-section
	square
	rectangle

Rectangular "brick":

How to cut	Shape of cross-section
	rectangle
	rectangle
 (Cut one "corner" off.)	triangle

Sphere:

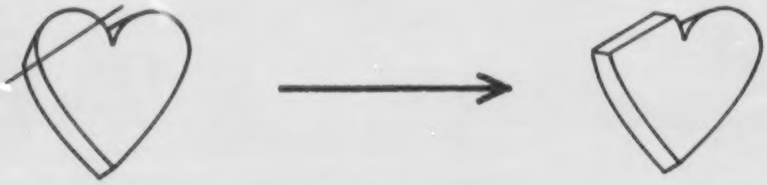
No matter how you cut it, the cross-section will always be circular.

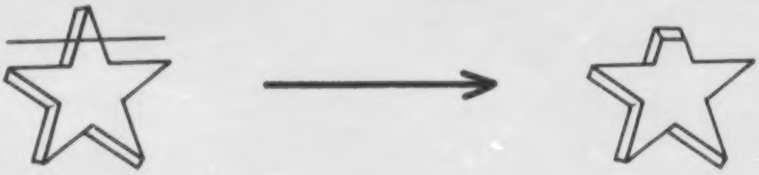
Neither of the two resulting solids will be a sphere.

Heart-shaped or star-shaped solid:

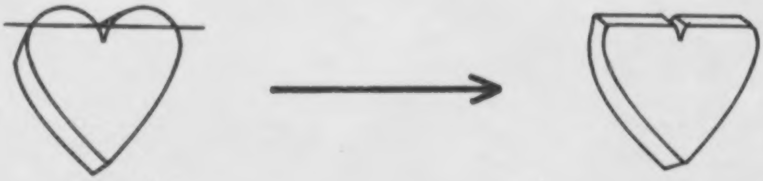
If the sides are perpendicular to the base you will always obtain either

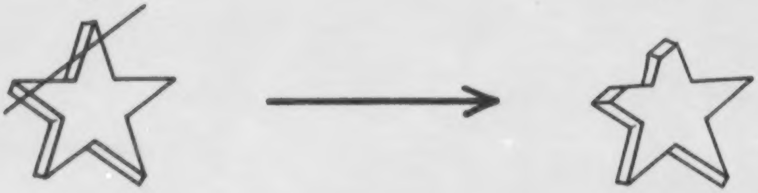
one rectangle





or two rectangles





when you cut it vertically.

EARLY WARNING:

In Lesson K55 each group of four students will again need two strings as in Lesson K43.

TITLE: Strings #2

MATERIALS:

Teacher - None

Students - Two pieces of string* or yarn* of two different colors, each piece about 2m long, and a set of K - A blocks for each group of four students (see the note in Lesson K8)

DESCRIPTION OF LESSON:

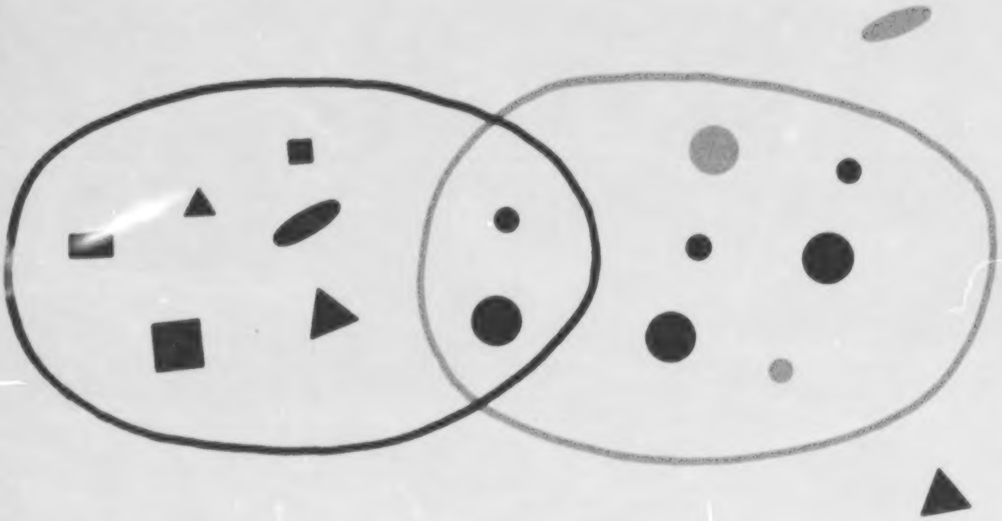
This lesson is a second chance for your students to tackle the problem of Activity 2 of Lesson K43, which was probably left unsolved.** You will find it useful to read through the description of that activity again before proceeding with this lesson.

Activity 1:

Distribute the strings (we will assume that they are yellow and blue again) and the K - A blocks. Tell your children to put all the red pieces in the blue string, and all the circles in the yellow string. Deal with the children's attempts at solving the problem as described in Lesson K43.

** Even if some of your students solved the problem the first time, it will probably still be worthwhile to go ahead with the present lesson.

The correct answer[*] is:



Give the students time to explore this situation. However, before you end the lesson or go on to Activity 2, the correct answer should be given, either by a group of students or by yourself.

Activity 2:

Only start this activity if you feel you have enough time.

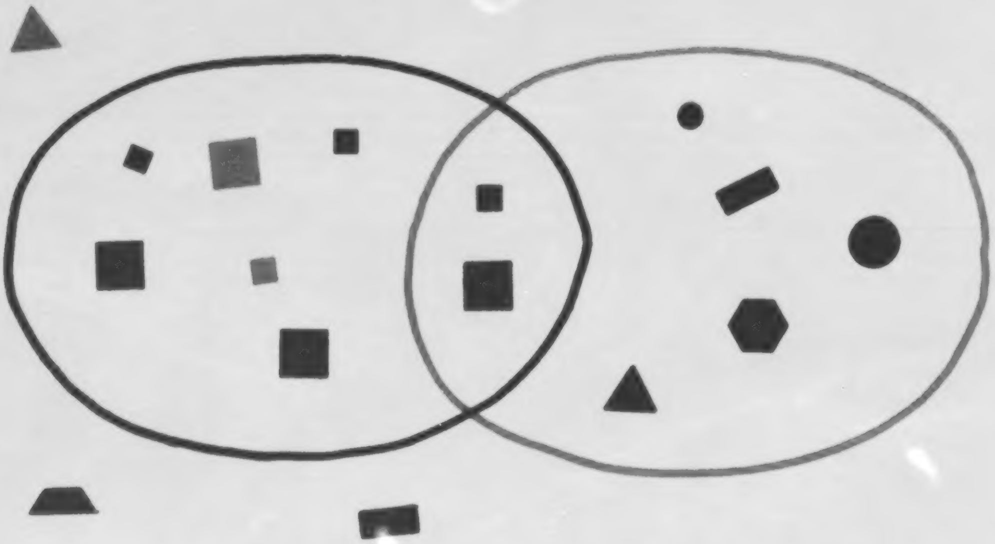
Ask the students to remove the K - A blocks from the strings.

T: This time I would like you to put all the squares in the blue string, and all the green pieces in the yellow string.

---

[*] Not all the blocks have been drawn.

The correct answer[*] is:



As you walk around the room checking the children's work, ask questions such as:

T: What shapes do you have here? (Indicate with your hand the region between the two strings.)

S: Green squares.

T: And here? (Inside the blue string but outside the yellow.)

S: Squares that are not green.

T: And here? (Inside the yellow string but outside the blue.)

---

[*] Not all the blocks have been drawn.

K55

S: Green shapes.

T: All the green shapes?

S: Not the green squares.

T: So, here the shapes are green but not square.

Can you give me some examples of shapes that don't belong in either string?

S: A yellow triangle.

A blue circle.

. . .

T: Is there any green shape outside both strings? (No)

Is there any square outside both strings? (No)

TITLE: Number Readiness #7

SUGGESTED ACTIVITIES (see the introduction to Lesson K3):

A. Hidden Dots

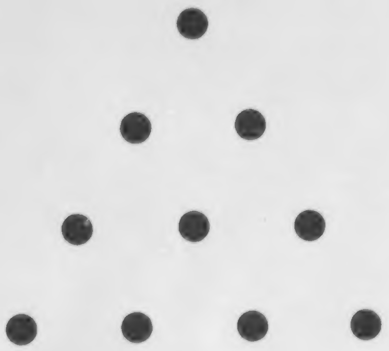
MATERIALS:

Teacher - A sheet of paper*

Students - None

DESCRIPTION OF ACTIVITY:

Draw the following array of dots on the board:



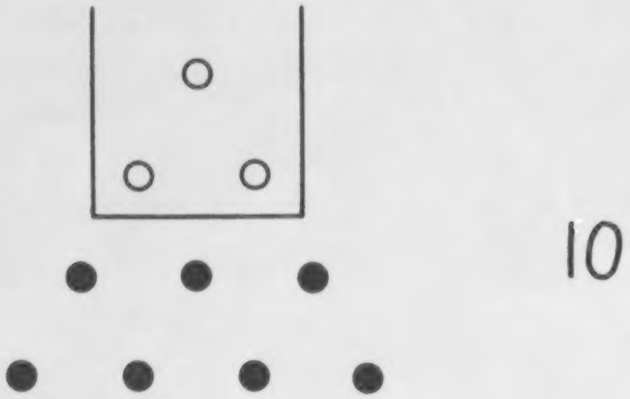
T: How many dots are there?

S: Ten.

Ask someone to write "10" on the board.

T: Close your eyes.

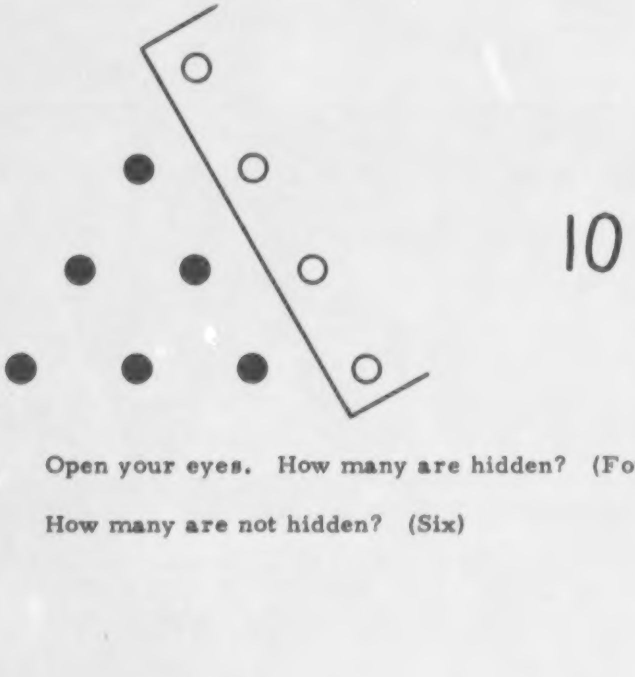
Hide some of the dots with a piece of paper before asking your students to open their eyes again.



T: How many are hidden? (Three)

How many are not hidden? (Seven)

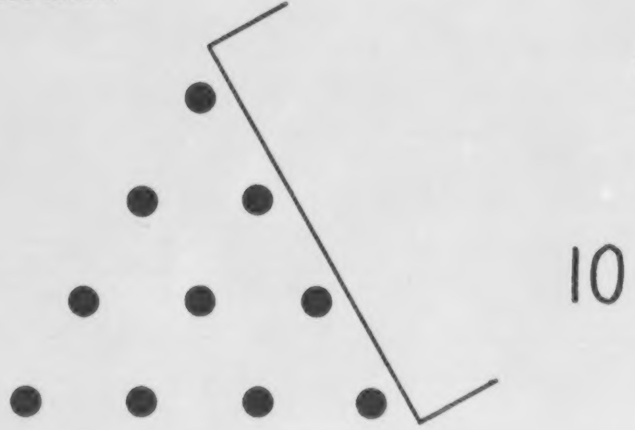
Close your eyes again.



T: Open your eyes. How many are hidden? (Four)

How many are not hidden? (Six)

Once more:

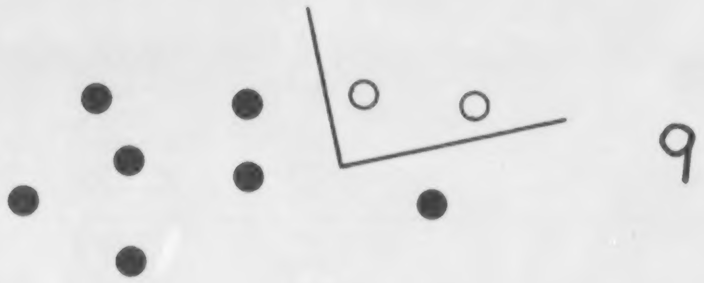


T: How many are hidden? (None)

How many are not hidden? (Ten)

Variation:

Draw the dots so that they do not form a systematic pattern. For instance:



B. The 0-99 Numeral Chart

MATERIALS:

Teacher - The 0-99 Numeral Chart

Students - None

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DESCRIPTION OF ACTIVITY:

Several ways of using the 0-99 Numeral Chart are suggested in Lesson K47. Please read these over and choose among them.

We do suggest that you include the following activity in your selection:

T: Start at "0" and read every other number.

When the class has done this, ask the children if they noticed anything special. Someone might realize that the numbers they read are arranged in columns in the 0-99 Numeral Chart (as also are the numbers they did not read). If a student gives this response, ask him or her to point out one such column. You could also copy some or all of these columns onto the board:

0	2	4	6	8
10	12	14	16	18
20	22	24	26	28
30	32	34	36	38
40	42	44	46	48

and so on.

For each of these columns, ask if there is something special about it. (In each column, the last digit of each numeral is the same.)

TITLE: Car Tracks #2

MATERIALS:

Teacher - None

Students - Track Pieces: 8 straight sections and 8 curved sections for each student involved in this activity (if you followed the suggestion made in Lesson K45, this will be one envelope of Track Pieces for each student)

Worksheets K36-I, II, III, IV, V; colored pencils* or crayons*

IMPORTANT NOTE:

The number of track pieces included in a classroom set allows 10 children to work on Car Tracks #2 activity at the same time. You will therefore need to repeat this activity several times working with a maximum of 10 students each time.

Meanwhile the other students will need something to be working on; we suggest the "Coloring By Numbers" pages from Lesson K36-2.

ORGANIZATION:

Remind the students how to do the "Coloring By Numbers" pages.

Since all the students will not be working on the same worksheets at the same time, we suggest that you write the full color chart on the board, using the appropriate color for the numerals (this chart is given in Lesson K36-2, p. 151).

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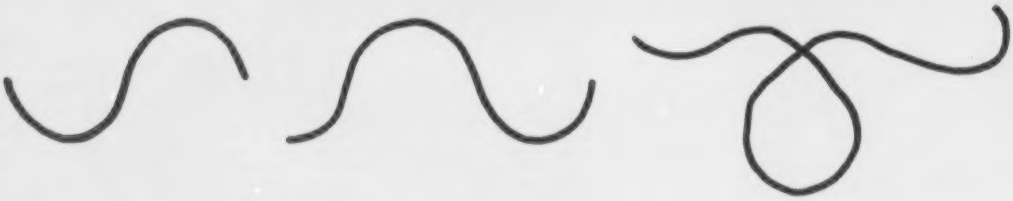
Select 10 students to work with you on Car Tracks.

Give the others a "Coloring By Numbers" worksheet to work on individually.

DESCRIPTION OF LESSON:

Form a small group with the 10 students you selected and remind them about the previous lesson (K45) in which they used the track pieces to build car racing tracks. Ask whether someone can draw any of these racing tracks from memory.

If all the drawings your children volunteer are of open curves:[*]



follow along one of the drawings with your finger and say:

T: On this racing track, the car can start here, and drive all the way to there. Can you think of a track where the car could just keep on driving and driving and driving?

After several attempts someone will surely come up and draw a closed curve.

T: Today I want you to build racing tracks like this where the car can just keep on driving without having to stop.

---

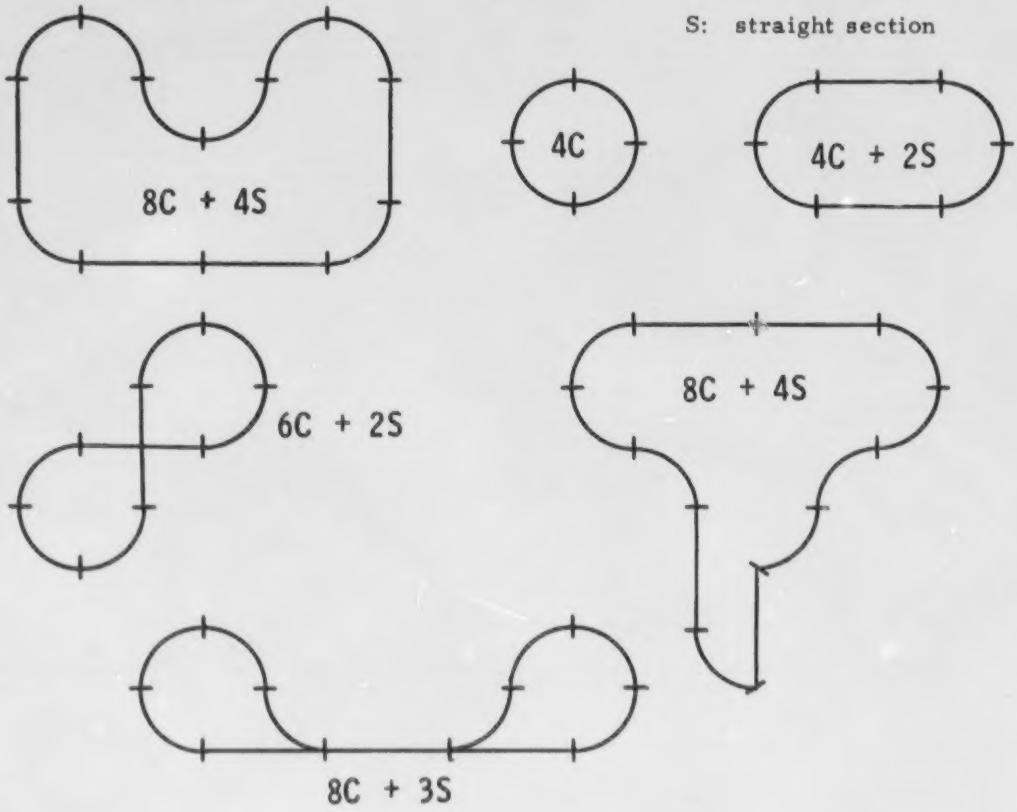
[*] If you are presented with both open and closed curves right from the start, follow along one of each kind with your finger and say:
T: On this racing track, the car can go from here to there.
But on this one, the car can keep on going around and around.

Give each child an envelope of Track Pieces (8 straight sections and 8 curved sections), and ask the students to try to build closed racing tracks. You should point out that you are not insisting that all 16 pieces be used in the construction of such a track.

Here are some possible closed racing tracks:

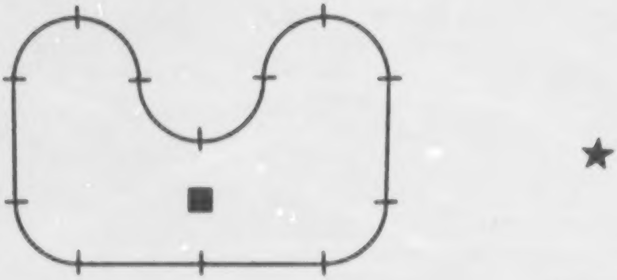
C: curved section

S: straight section



After the children have had sufficient time to build these closed racing tracks, call them around the work of one of the children (the following track, for example) and say:

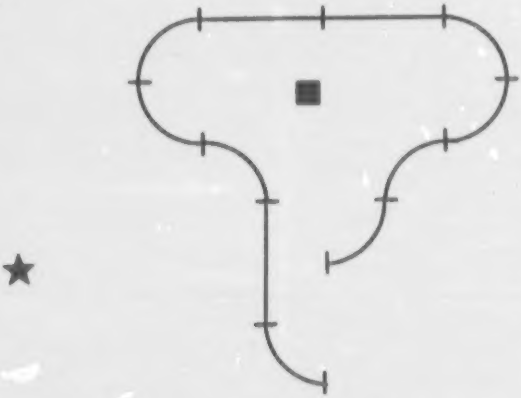
K57



T: I know a child who lives right here not far from this car racing track. (Point to a spot outside the closed track, for instance ★.) His mother told him he must never cross the racing track because he might get run down by a racing car. Where is he allowed to go? Where is he not allowed to go?

Now, there's a little ice-cream store right here. (Point to a spot inside the track, for instance ■.) Do you think he will be allowed to go there to buy an ice-cream? (No; he would have to cross the racing track.)

Take some track pieces and very quickly build an open racing track such as the following:



T: I know another child who lives right here, next to this other racing track. (Once again, point to a spot such as ★.) She is not allowed to cross the racing track either, for the same reason. Where is she allowed to go?

There's an ice-cream store here too. (Point to a spot such as ■.) Will she be allowed to go and buy an ice-cream at that store? (Yes; there's no need to cross the track in order to reach the store.)

Ask someone to show you how the ice-cream store could be reached without having to cross the racing track.

Give the 10 students in the first group a Coloring By Numbers worksheet, and ask them to work on their own while you begin the lesson with a new group.

IMPORTANT NOTE:

Once you have taught this lesson there should be at least one envelope of track pieces (8 straight sections and 8 curved sections) available in the classroom for students who wish to experiment and play with them during their spare time.

EARLY WARNING:

You might want to use an overhead projector in Lesson K58. If so, you should make any necessary arrangements ahead of time.

K58

TITLE: Four Frogs

MATERIALS:

Teacher - Colored chalk* (or an overhead projector* and pens* for writing on transparencies)

Student - None

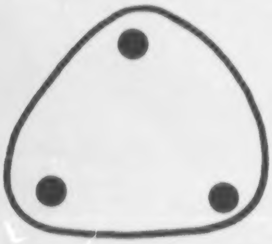
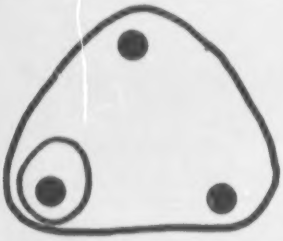
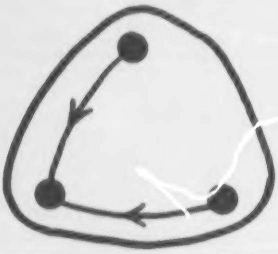
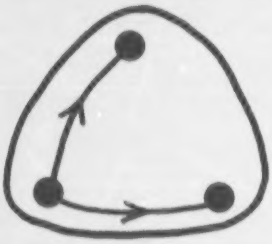
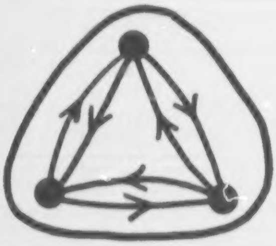
NOTE:

This story was written by an eleven year old child, called Patti, during the course of an experiment in which children were given a succession of pictures (in this particular case, the ones that illustrate this story) and asked to write a story about them.

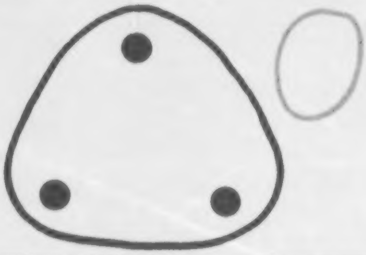
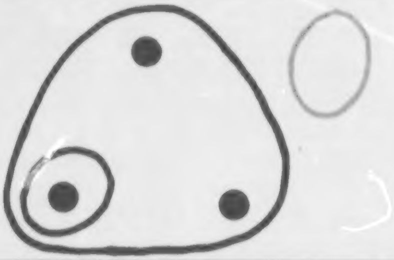
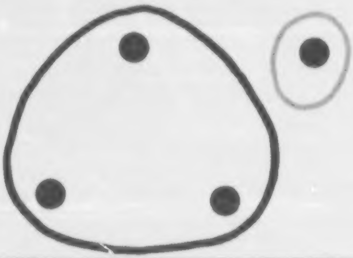
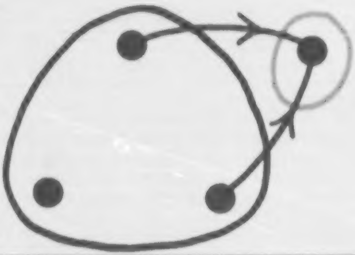
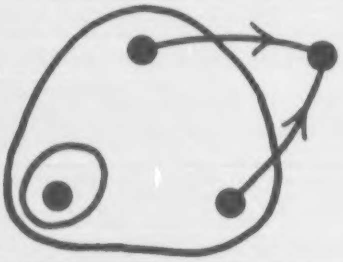
DESCRIPTION OF LESSON:

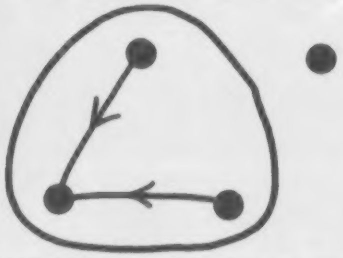
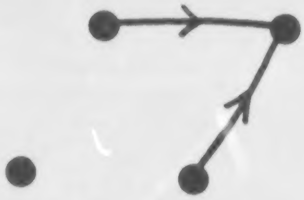
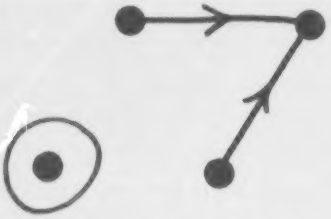
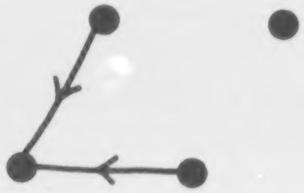
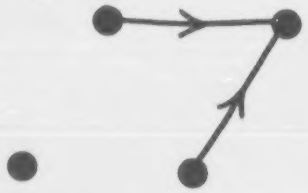
This lesson consists of your drawing and modifying a mathematical picture while telling a story to your children. The children have nothing to do but watch, listen and (at appropriate moments) react. In the pages that follow we have provided you with a succession of pictures, just as if it were a filmstrip. You should not draw such a sequence of pictures for your children. Instead, you should draw the first picture and tell the first part of the story. Next add the blue string and tell that part of the story. Then erase the blue string and add the red arrows. At each stage, make as minor a modification of your picture as possible so that it ends up looking like the corresponding "frame" in this description.

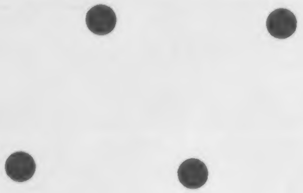
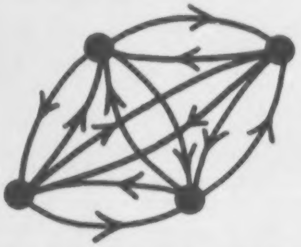
Remember to make a large, clear drawing, with big dots, long and easily visible arrows, thick strings (draw them with the side of a small piece of chalk or by using a thick visual aid pen).

	Once upon a time there lived three frogs. Their home was in a forest but every day they went to the swamps to play.
	The oldest frog was Harry. (As you say this, draw the blue string. You could ask, "Where is Harry?" and let a child respond by pointing to the dot in the blue string.)
	Harry was also the strongest. That is why the other two frogs liked to play with him.
	Harry also enjoyed playing with the smaller frogs.
	They were all three happy together in the swamps.

K 58

	One night, the two little ones had a dream that someone would come. They told Harry about it, but he didn't believe them.
	The next night, Harry had the same dream, that someone would come.
	When it was daylight they all went to the swamps. There was a new frog!
	The two little ones left Harry and went to play with the new arrival.
	The next day, they did the same thing, and Harry got very mad.

	Harry got into a fight with the new frog, and Harry won. So the two little frogs started to play with Harry again.
	But then they felt sorry for the new frog, and so they played with him.
	Harry got even madder at the new frog.
	So that night Harry talked with the little frogs about his new idea: In the mornings they would play with him, ...
	... in the afternoons they would play with the new frog, ...

	. . . and in the evenings each frog would play by himself. By the end of a week they were sick of this.
	Finally, they all became good friends and enjoyed playing together.

When you have finished telling this story, don't rush the children into another activity. Instead, let them feel free to talk about the story (with you or with their classmates) or to make a drawing about it if they wish.

K59-1

TITLE: Transforming a Number #2

Repeat Lesson K21-1.

OPTIONAL MODIFICATION:

You might want to use a different number (say, nine) this time. Then you could end the activity as follows:

T: We have nine birds.

Can someone come to the board and make it less than nine?

Can someone come to the board and make it more than nine?

Can someone come to the board, and move the checkers without changing how many birds there are.

IMPORTANT NOTE:

It is suggested that Lesson K59-2 be taught on the same day as Lesson K59-1. There is a question in Section One of this guide whose answer provides more information on this point.

EARLY WARNING:

Lesson K60 calls for a coat or jacket whose inside and outside are different colors. You will also need to prepare some "bands" beforehand. See the lesson for details.

K59-2

TITLE: Coloring By Numbers #2

MATERIALS:

Teacher - None

Students - Worksheets K59-I, II, III; colored pens,* pencils,* or crayons*

IMPORTANT NOTE:

Three worksheets are provided to accompany this lesson. It is not intended that every child should color all three in one lesson! Some students have been known to work on the same worksheet for several days!

Save any worksheets that are not completed during this lesson. Feel free to use them at a later time as individual work.

DESCRIPTION OF LESSON:

Your students are probably quite familiar with this sort of activity. It is important, however, that everyone knows what color pen (pencil or crayon) to use for the different numbers. (It might help if you wrote the various numerals in the appropriate color on the board.)

Here is the complete color chart for the three worksheets:

2	Green	5	Red
3	Blue	6	Black
4	Brown	7	Yellow

K60

TITLE: One Side - Two Sides #2

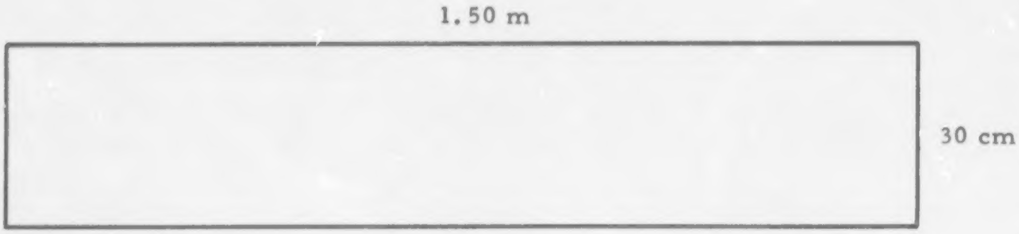
MATERIALS:

Teacher - A coat* or jacket* whose inside and outside are different colors (for example, a reversible parka); one large cylindrical band* and one large Moebius band*[**] (see the note on preparation below); one colored pen* or magic marker*

Students - One small cylindrical band* and one small Moebius band* (see the note on preparation below); one colored pen*, pencil* or crayon*

PREPARATION:

These bands are easy to make. For each of the two large ones you will need a long strip of flexible cardboard or paper of sufficient weight that the colored pen or magic marker that you will be using during the lesson does not bleed through it. The suggested dimensions of each strip are as shown below.



[**] Named for August Ferdinand Möbius, German astronomer and mathematician of the 19th century. We have chosen the approved modified spelling "Moebius" throughout this guide.

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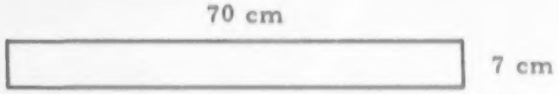
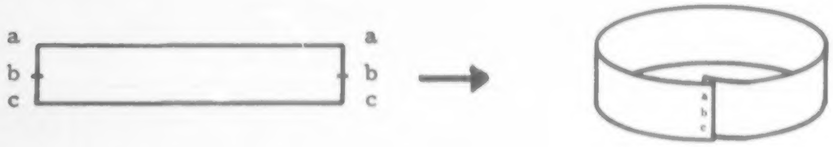
For the students' bands, use a paper strip of smaller dimensions (an easy way of doing this is to cut lengths from a roll of tape such as is used in cash registers). The suggested dimensions of each strip are as shown below.



Be sure that you use paper of sufficient weight that, if the students are to be using colored pens, these will not bleed through it. It might be advisable to prepare a few extra student Moebius bands. The results of what is to be done in this lesson might be so surprising to your children that they will want to repeat the individual work, just to check that they didn't make a mistake.

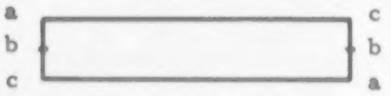
To make the cylindrical band:

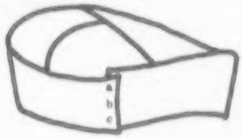
Stick the two short edges together, taking care to stick the points which are labeled with the same letter in the picture below on top of each other.



To make the Moebius band:

Proceed as in the case above, but this time refer to the picture below. In order to be able to place the appropriate points on top of each other, you will have to give the strip a twist before gluing.





DESCRIPTION OF LESSON:

Show the children a coat (or jacket) whose inside and outside are different colors. The children will probably notice this fact fairly quickly. Conclude that a coat has two sides. If the coat which you are using for this demonstration is in fact reversible, show the children how you can wear it right side out and also inside out. Point out, however, that not all coats have this possibility, and that in fact, for most coats, you have to be careful not to wear them inside out.

Now produce the cylindrical band.

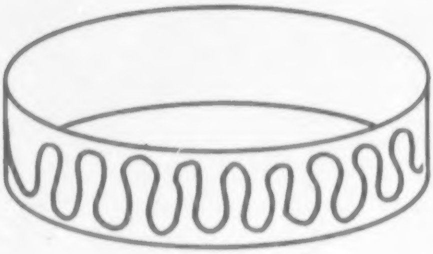
T: Does this also have two sides?

S: Yes.

T: Let's color one side red (or whatever is the color of your pen).

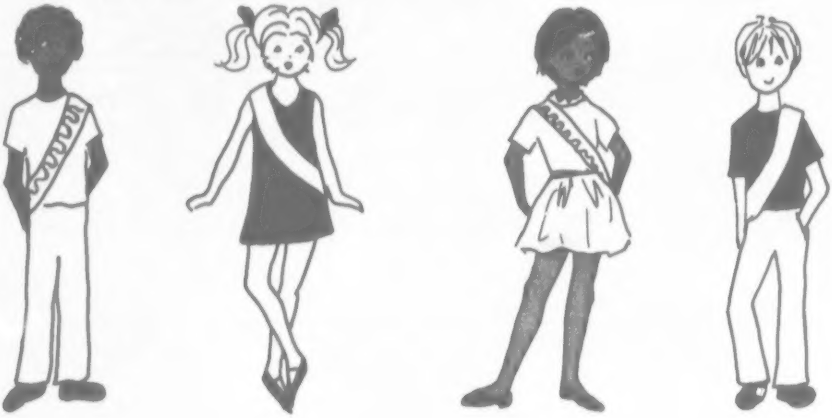
K 60

Let a child quickly draw a red squiggle on the outside of your cylindrical band.



Give everyone a chance to notice that one side is now marked in red while the other is still unmarked.

Some of your children might enjoy being allowed to wear the band (with either side showing) as a sash.



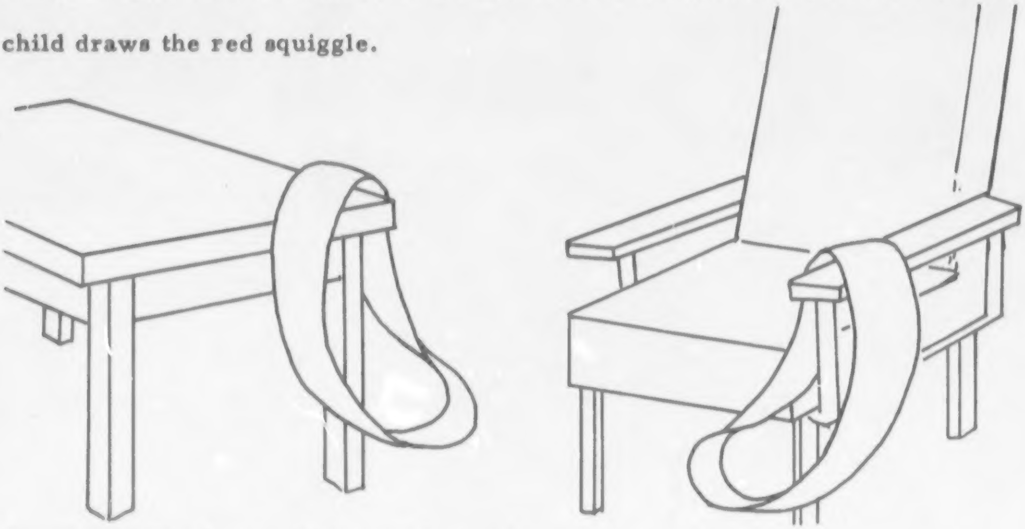
Next, produce your Moebius band.

T: What about this? Does it have two sides?

In all probability, everyone will think that it does.

T: Well, let's color one side red.

Let a child do this. A practical way of managing this is for you to slide the Moebius band over the corner of a table or over the arm of a chair while the child draws the red squiggle.



Surprise! The band will be marked with red all over!

Hold up both bands so the students can notice that, while the Moebius band is marked all over with red, the cylindrical band has only one side marked with red, the other side being unmarked. (Don't belabor this point, just let them look at both bands for a few minutes.)

Proceed next to the following individual work. Distribute the small cylindrical bands and colored pens (pencils or crayons).

Ask the students to predict what will happen if they color one side. Then let them do so. Suggest that they choose a place to work where they can slide the bands over the corner of a table or a chair.

When the coloring has been done, they should let you know individually if the band has one side or two sides. As each child does this correctly, give him or her a small Moebius band to color.

If some of your children want to know how these "funny strips" are made, tell them that they will find out in a later lesson. (This is shown in Lesson K69: One Side - Two Sides #3.)

NOTE:

> You might be wondering why the Moebius band is introduced. The primary reason is that it makes the children think more deeply about the more usual two-sided surfaces. Your students are familiar with many examples of such surfaces (a piece of paper, a table-cloth, a glove, a dress). As they see in this lesson, the Moebius band has only one side. This surprising discovery brings into question the implicit knowledge a child has about two-sided surfaces, and thus may be the cause of his or her realizing some of their properties.

TITLE: Interpretation of an Arrow Picture #1

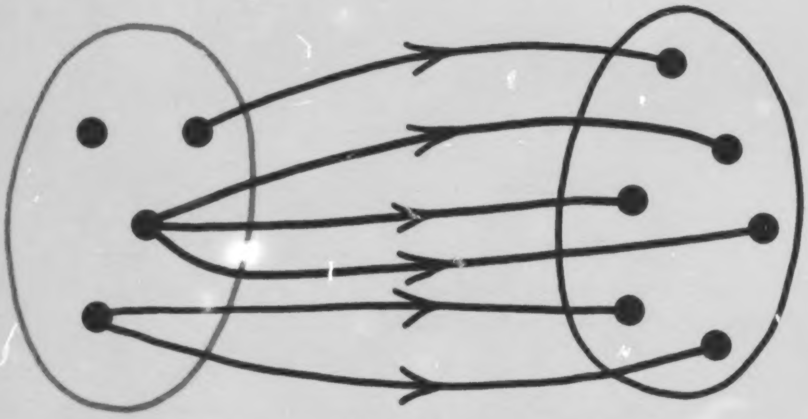
MATERIALS:

Teacher - Colored chalk*

Students - None

DESCRIPTION OF LESSON:

Draw the following arrow picture:



T: Usually, I make up a story to go with our picture. Today it's your turn. Try to find a story that goes with this picture.

You might have a certain amount of "editing" to do as the children's stories are being told. For each story, the following things need to be clarified.

In each string, what are the dots for?

What are the arrows for? **

** Within a story, all the arrows should have the same meaning.

Here is an example:

S: I have a story about dogs.

T: Where are they in my picture?

S: In the first string (the one on the left).

Let the child touch each dot in this string with his or her finger.

T: What are these dogs doing?

S: Chewing bones.

T: Where are the bones?

S: In the other string.

Once again, let the child touch each dot in this string with his or her finger.

T: And what are the arrows telling us?

S (Tracing along some of the arrows): This dog is chewing this bone, and this dog is chewing this bone.

Now ask the class a couple of questions about this story. For instance:

T: Which dog has the most bones?
What about this dog (the one without any bones)?

Here are some other examples of stories that children have invented:

a) Dots on the left: Children.

Dots on the right: Pets.

Arrows: "You are my pet."

b) Dots on the left: Pets.

Dots on the right: Children

Arrows: "I am your pet."

c) Dots on the left: Children.

Dots on the right: Other children.

Arrows: ... tells a secret to his or her friend ...

d) Dots on the left: School buses.

Dots on the right: Children.

Arrows ... picks up ...

Sometimes it happens that the children keep suggesting variations of the first story. For example:

1) Dots on the left: Dogs.

Dots on the right: Pieces of meat.

Arrows: ... chews ...

2) Dots on the left: Dogs.

Dots on the right: Dog biscuits.

Arrows: ... chews ...

In such a case you could ask if someone can make up a story about something other than dogs chewing something.

NOTES:

1. Occasionally, a child suggests a story which, despite all your efforts, you cannot fit with the arrow picture. In such a case, say something along the following lines:

   T: That's a nice story, but I don't think it fits my arrow picture.

   You might want to draw an arrow picture that fits the child's story (if that's possible!)

2. Sometimes a child suggests a story that isn't at all compatible with the arrow picture. For example:

   Dots on the left: Children.
   Dots on the right: Mothers.
   Arrows: "You are my mother."

   Let the class discuss the story. Try to point out that one of the children would have three mothers, which is not possible. In this particular example, however, you can easily make this story fit the arrow picture by putting the mothers in the left string and the children in the right string. The arrows could then say, "You are my child."

TITLE: Number Readiness #8

SUGGESTED ACTIVITIES (see the introduction to Lesson K3):

A. Point of View

MATERIALS:

Teacher - Colored chalk;* a ruler* or straight edge*

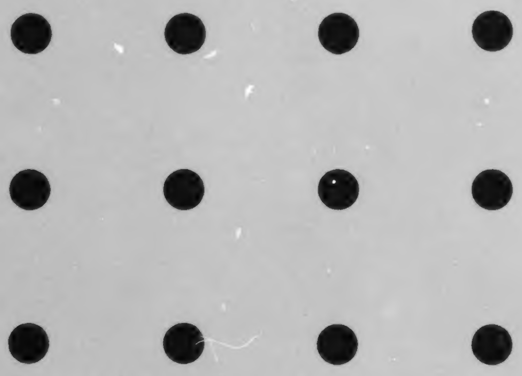
Students - None

DESCRIPTION OF ACTIVITY:

T: Have you ever seen a parade?

Discuss briefly your children's experiences of parades.

Draw the following array of 12 dots on the board:



T: Here are some soldiers in a parade. How many are there? (12)

Ask someone to write " 12 " on the board.

K62

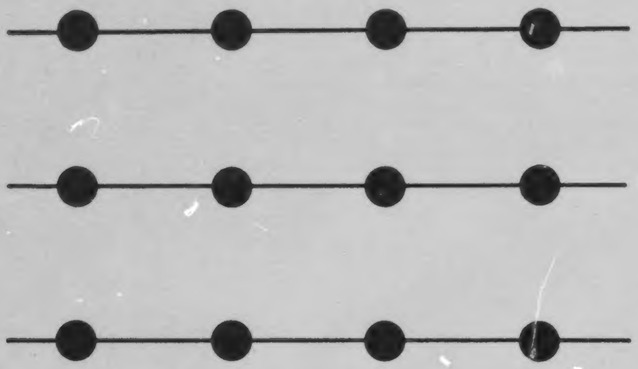
T: How does it look as if they are arranged?

S: In three rows.

T: How many soldiers are in each row?

S: Four.

Demonstrate this with a ruler or straight edge:



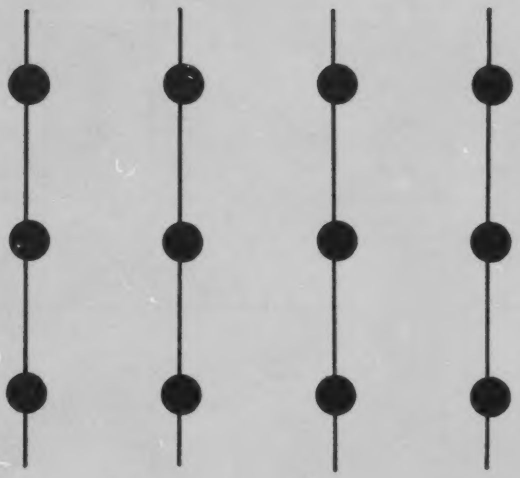
and write:

$$12 = 4 + 4 + 4$$

T: Is there any other way of looking at them?

S: Four columns of three.

Demonstrate this, as in the first case:

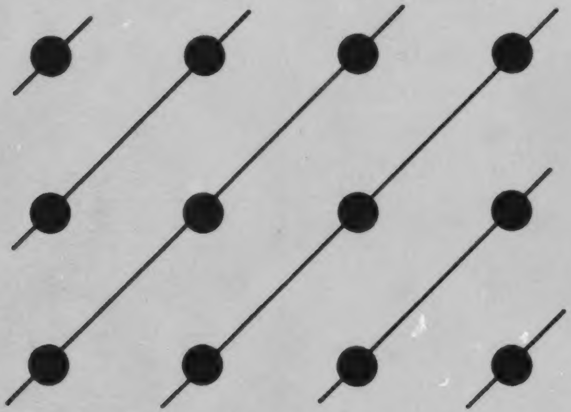


and write:

$$12 = 3 + 3 + 3 + 3$$

T: Does anyone see another way of looking at these soldiers?

Someone might come up and show the following:[*]



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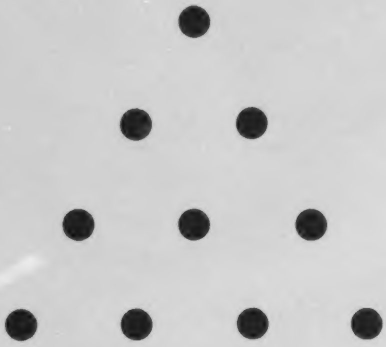
[*] If necessary, show this last one to the class yourself, saying that it shows another way of looking at the soldiers.

Record this answer by writing:

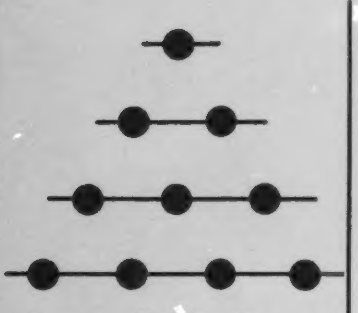
$$12 = 1+2+3+3+2+1$$

NOTE:

If the children seem interested, you could repeat the same activity with the following configuration:

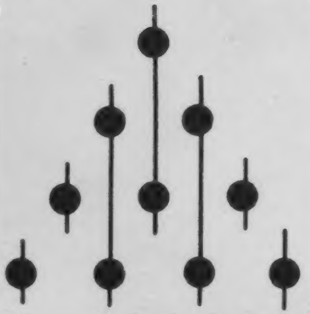


which could lead to:

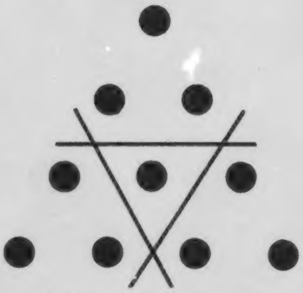


$10 = 1+2+3+4$

$10 = 4+3+2+1$



$10 = 1+1+2+2+2+1+1$



$10 = 3+3+3+1$

and so on.

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B. Dot-to-Dot Pictures

MATERIALS:

Teacher - None

Students - Worksheets K62-I through K62-XIV

DESCRIPTION OF ACTIVITY:

Your pupils are probably quite familiar with normal dot-to-dot pictures, where you start at 0 or 1, and count by ones. In addition to that kind of worksheet, with this activity we provide some slightly different ones that make use of some other counting skills (counting by twos; counting backward; and so on).

K62-I, II, III	Normal dot-to-dot pictures: start at 1, count by ones.
K62-IV, V, VI	Dot-to-dot pictures in which you are to count by ones, but you don't start at 1. Give the following instruction: Start at the star and join the dots, counting by ones.
K62-VII through K62-XI	Dot-to-dot pictures in which you are to count by twos, fives, tens.
K62-XII, XIII, XIV	These could be used as normal dot-to-dot pictures. However, you should instruct the children who are ready for it to start at the star and join the dots, counting backward.

For this lesson, you could either start everyone on Worksheet K62-I, or else you could assign worksheets on an individual basis according to the ability of the child.

Needless to say there are far too many worksheets here for one lesson! One more lesson (K71) is scheduled in which dot-to-dot pictures are to be used. As far as any worksheets you have left over after these two lessons are concerned, you should feel free to use them at any later time either as full group, small group or individual activities.

NOTE:

The slowest children should be encouraged to count under their breath as they complete the pictures.

EARLY WARNING:

Lesson K63 calls for a square grid (see the note in Lesson K27).

K63

TITLE: Treasure Map

MATERIALS:

Teacher - A square grid* (see the note in Lesson K27); colored chalk;* (Optional) some stick-on stars*

Students - Worksheets K63-I, II; a pencil or crayon*

DESCRIPTION OF LESSON:

Your students will probably remember that the square grid is the city in which Nick lives (see Lesson K27 for details about this).

Tell them that they are right, but add that today Nick has a holiday, and so he doesn't have to go to school. Instead, he's planning to go on a treasure hunt around the city.

T: In order to follow where Nick goes on his treasure hunt we must make sure we all agree on the directions. There are four ways he can go. He can go like this. (Motion with your hand following a street from the bottom to the top of the square grid.) If he does that he's going UP.

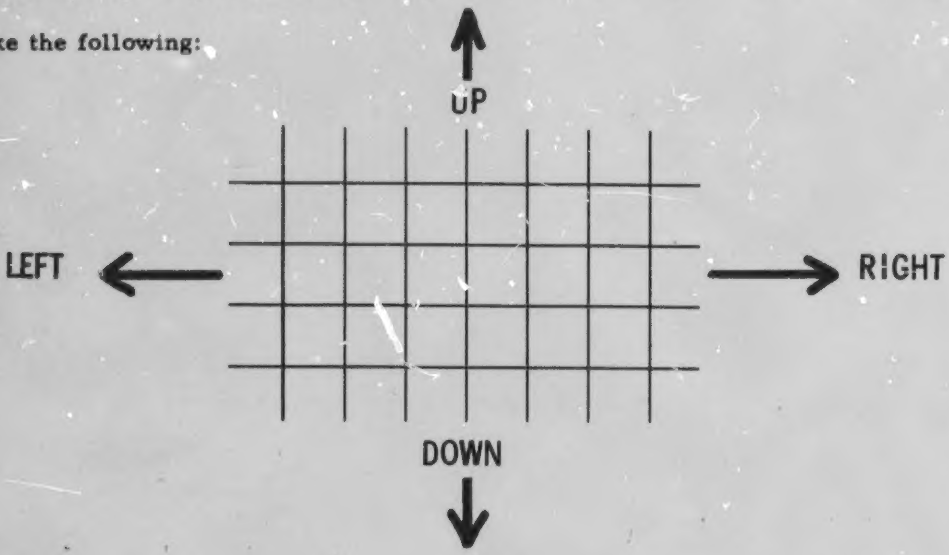
Draw an arrow in the appropriate direction and write "UP" next to it. Proceed similarly for "DOWN."

T: Now everybody stand up and face the map of Nick's city. Where's your right hand?

When everyone has correctly indicated his or her right hand, trace along a street from left to right.

T: If he does this, then he's going RIGHT.

Draw an arrow in the appropriate direction and write "RIGHT" next to it. Proceed similarly for "LEFT." By now your square grid looks something like the following:



Ask a volunteer to come to the board to help Nick on his treasure hunt.

Indicate the place from which Nick is going to start and give a sequence of directions such as:

Up: three blocks.

To the left: two blocks.

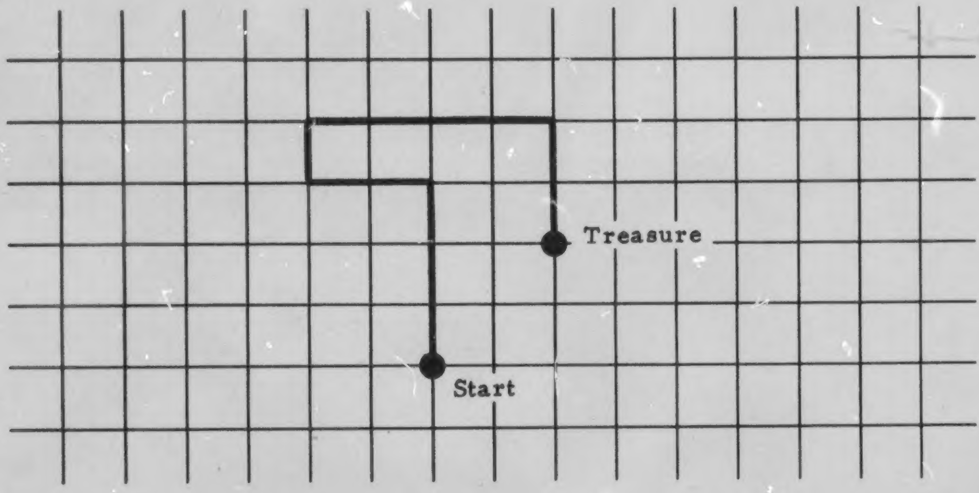
Up: one block.

To the right: four blocks.

Down: two blocks.

There is the treasure!

These directions should be given one at a time, with your volunteer being given sufficient time to draw the corresponding segment of the treasure hunt after each direction.



Use this collective example as an opportunity to remind those students who have forgotten how to count blocks (this was described in Lessons K27 and K39).

Either erase what you have on the board, or else remove whatever square grid you are using from sight.

Distribute copies of Worksheet K63-I.

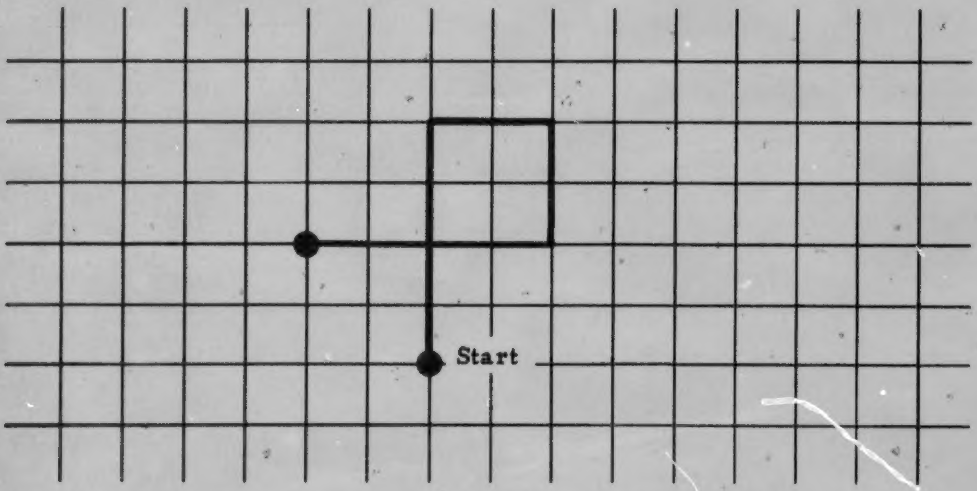
Make sure each child has his map correctly oriented, and point out to the class the arrows labeled "up," "down," "left," and "right."

Now start giving directions. (You will find this easier if you have prepared yourself before the lesson by marking a location for the treasure, and a route from the start to the treasure on your own copy of Worksheet K63-I.) After giving each direction, allow the children sufficient time to draw the corresponding part of the treasure hunt on their worksheets.

When you say, "Stop!" you should check each child's final destination to see who found the treasure. (To add to the children's enjoyment, you might want to use "real" treasures, such as stick-on stars, which could be attached to the appropriate location on the worksheets of those children who ended up in the right place.)

You will probably have time for more than one treasure hunt. If so, you should use a new map for each hunt.**

Be sure to include at least one instance where the path to the treasure crosses itself, as in the case below:



Directions for this path are given on the next page.

** A second copy of the first grid is printed on the back of Worksheet K63-I. Another grid, which gives you the opportunity to plan slightly more complicated routes, is provided as Worksheet K63-II. A second copy of this grid is printed on the back of that worksheet.

Directions:

Up: four blocks.

Right: two blocks.

Down: two blocks.

Left: four blocks.

K64

TITLE: One Way Roads #2

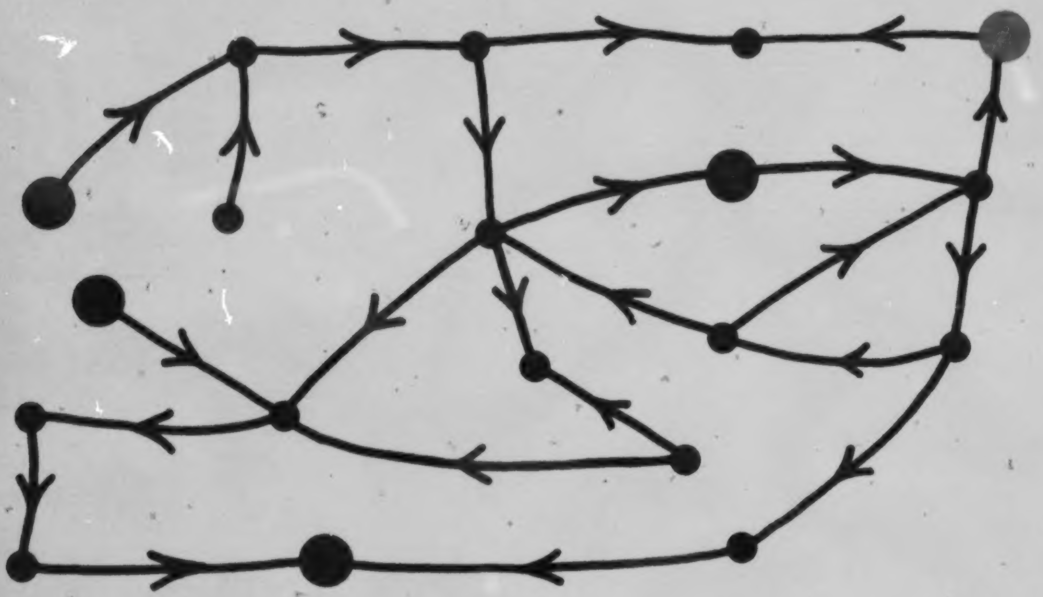
MATERIALS:

Teacher - One Way Road Map #2; a pointer*; colored checkers (for example, demonstration Minicomputer checkers); some scotch tape*; (optional) some small pieces of colored paper* (of the same colors as the checkers you are using)

Students - None

DESCRIPTION OF LESSON:

This lesson follows the same pattern as Lesson K34. Attach your copy of One Way Road Map #2 to the board. This map is reproduced below. For the moment, don't attach any special significance to the colored dots; they are included for reference later in the lesson.



T: This is the map of my garden. If you would like to take a walk in it, you will have to follow the arrows. Who would like to try? Here is the gate into the garden. (Point to the big, black dot on the left.)

Let several children each use a pointer to trace along a walk in the garden. As in the previous one way roads lesson, if anyone makes a mistake by trying to go against the direction of an arrow, the rest of the class should protest, by raising their hands, for example.

T: Now I am going to point out some bushes that have just flowered. You may pick some of the flowers if you can get there!
Here are the red roses. (Tape a checker on top of the dot that is colored red in the above picture.)

Let several children show different ways of reaching the red dot from the big, black dot. You should insist that each volunteer has already thought of a path before coming to the board. This avoids the long pauses that result from a child's standing in front of the board pondering what to do.

From ● to ●

If you like, you could give each child who reaches the red dot a piece of red paper in token of the "flowers" he or she has picked.

Proceed in a similar fashion to go

From ● to ●

Remove the checker from the red dot before you tape one on top of the yellow dot.

From ● to ● ●

Remove the checker from the yellow dot before taping one on top of the orange dot.

Probably several children will volunteer to make an attempt at this before anyone notices, and is able to explain (in his or her own words), that it is impossible to reach the orange dot.

Here is the final path to be taken:

From ● to ● ●

TITLE: Number Readiness #9

MATERIALS:

Teacher - A magnetic board* (see the note in Lesson K6); demonstration Minicomputer checkers

Students - None

SUGGESTED ACTIVITIES (see the introduction to Lesson K3):

A. How Many More?

DESCRIPTION OF ACTIVITY:

Start the lesson by having an informal talk about the animals you usually see on a farm. The students will probably volunteer the names of several of them (for example, pigs, cows, and chickens).

Place three red checkers on the magnetic board and say,

T: These are for pigs. How many pigs are there? (Three)

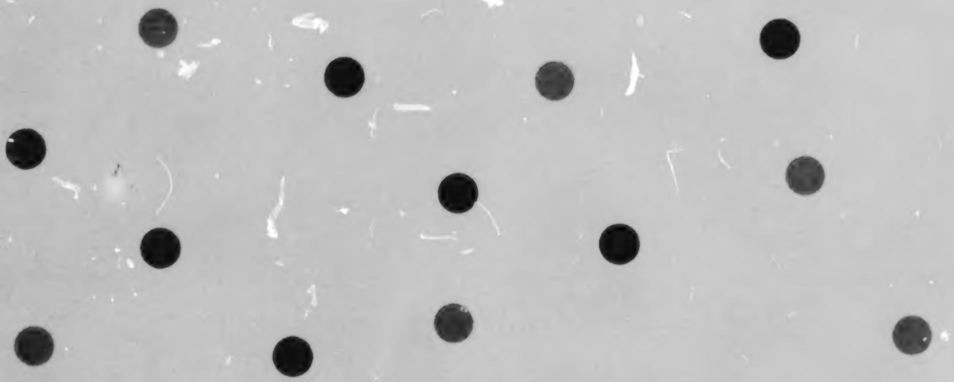
Add four blue checkers and say,

T: These are for cows. How many cows are there? (Four)

Finally, add six yellow checkers and say,

T: These are for chickens. How many chickens are there? (Six)

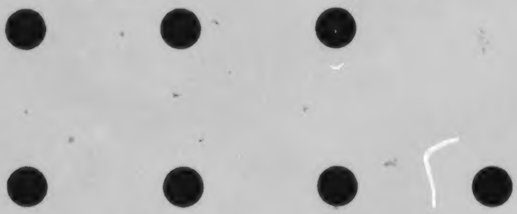
Your magnetic board will now look something like this:



Ask someone to count how many animals there are altogether (13), and to point to "13" in the Numeral Row. Then let somebody else remind the rest of the class what kind of animals they are.

T: During the day, they like to play around in the fields, but at night they all go back to their barn. Here are the pigs and the cows going back to the barn.

Move the checkers around on the board (put the yellow ones aside in a corner of the board for the moment).



T: Are there more pigs or more cows?

S: More cows.

T: How do you know?

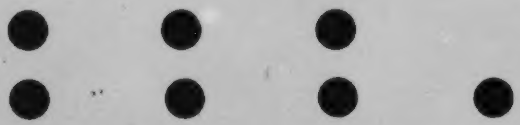
S: There are four cows and only three pigs.

S (Pointing to the solitary blue checker on the right): I know because of that one.

T: That's right: there are more cows than pigs.
How many more?*

S: One.

Move the two rows of checkers closer to each other,



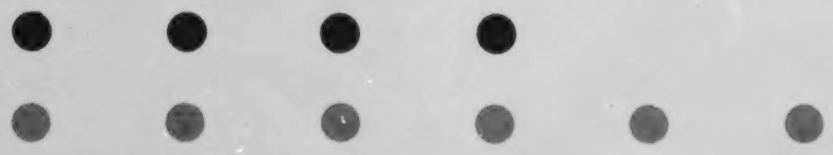
point to the solitary blue checker on the right and say,

---

* Some children might misunderstand your question and answer, "Four." If this happens, say,
T: It's true that there are four cows. That means there is one more cow than the three pigs, right?

T: Right: one more.

Move the checkers around on the board again, but this time leave the three red ones in one corner of the board. You will be left with the following:

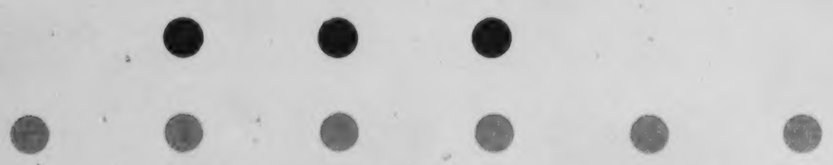


T: Now the chickens are ready to go to bed too!

Are there more chickens or more cows?

How many more chickens?

Finally, bring back the red checkers, and leave the blue checkers in one corner of the board.

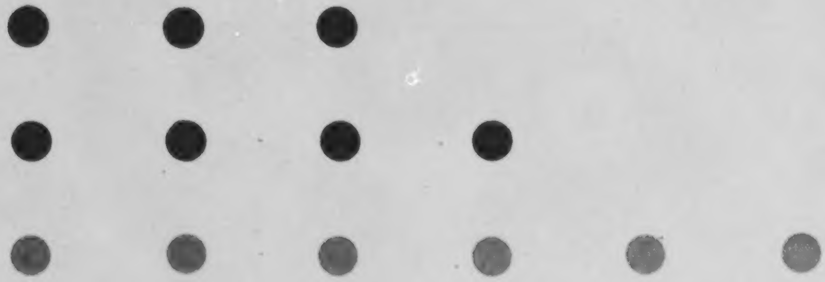


Ask a series of questions similar to those asked in the previous two cases.

B. Animal Hide-and-Go-Seek

DESCRIPTION OF ACTIVITY:

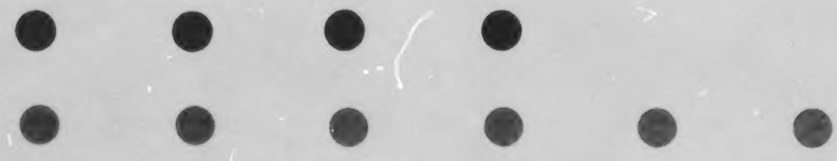
Take the checkers that you used in the first activity and rearrange them on the board:



As you do this, repeat: three pigs;
four cows;
six chickens.

T: These animals love to play hide-and-go-seek. Look at them carefully, because in a while some of them will go and hide.

Ask the children to close their eyes, and when they have done so quickly remove the three red checkers:



T: Who has gone to hide?

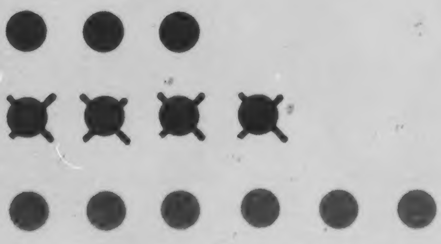
S: The pigs!

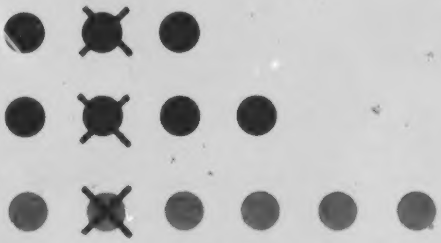
T: How many pigs?

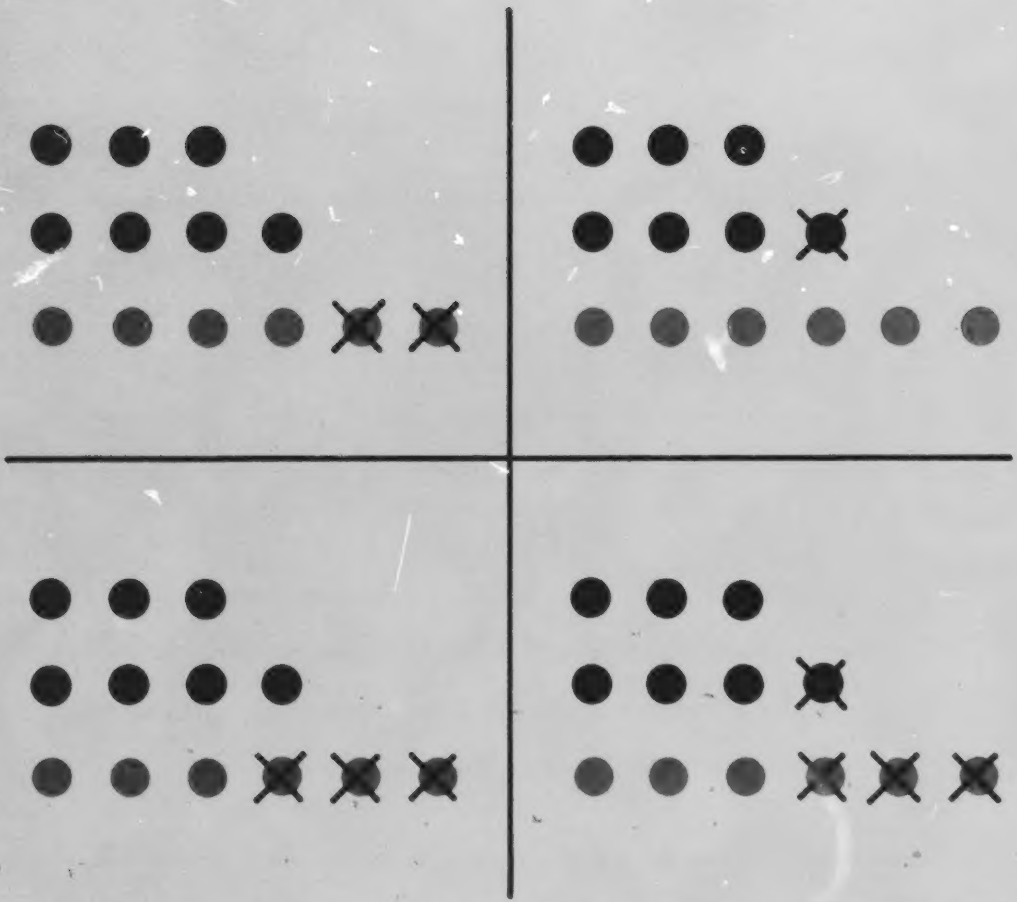
S: Three.

Show the three red checkers again and replace them in their original position.

If your students enjoy this activity, here are some suggested sets of checkers for you to remove. They range from easy to difficult. Choose ones which you consider appropriate to your children's abilities.







Before you start each exercise, always return the checkers to the original configuration, and give the children a chance to recall how many of which color checkers you are using.

K66

TITLE: Catch the Tiger #1

MATERIALS:

Teacher - One copy of the Catch the Tiger Game Mat; a small toy tiger* (or any other wild animal) or a demonstration Minicomputer checker; two dice*

Student - None

IMPORTANT NOTES:

1. You are provided with several Catch the Tiger Game Mats on a large sheet of paper. Cut one of them out for use in this lesson, and save the others for later use. The "Catch the Tiger" game is played again in Lesson K75, but you should feel free to play it as often as you like after this lesson. To increase the life of these Game Mats, you could cover each of them with transparent contact paper.

2. This game is more enjoyable if there are not too many players in each group of "hunters." If you can obtain the services of another adult, it would be a good idea to have two games going at the same time. (Of course, in order to be able to do this you will need twice the amount of equipment called for above.)

DESCRIPTION OF LESSON:

Proceed as follows for each "Catch the Tiger" game that you have going in your classroom.

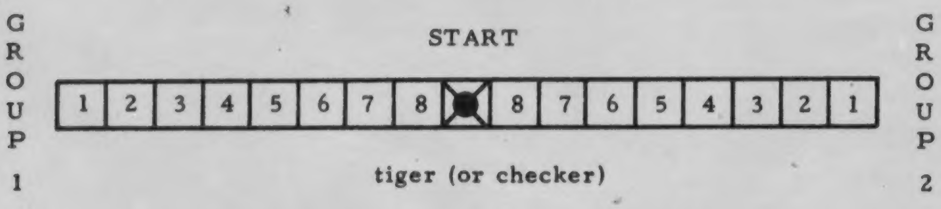
Show your children the tiger and explain that you are going to go on a tiger hunt. (Modify this story as necessary if you are using any other wild animal. If you are using a checker, explain that you are going to use the checker to stand for the tiger.)

T: This tiger lives in the jungle, where he feels safe from hunters. Here's the track in the jungle that he likes to prowl along.

Show the children the Game Mat, and place the tiger on the central square.

T: You are going to be the hunters. I'll divide you into two groups.

Do this, and stand one group at one end of the Game Mat, and the other group at the other end.



T: As long as the tiger prowls up and down this track he's safe, but as soon as he steps off this end of the track this group catches him, and as soon as he steps off the other end, the other group catches him. Let's go hunting.

Let one member of each group roll a die. The group that gets the highest number plays first.

Rules of the Game:

1. The two groups take turns.
2. The members of a group take turns to roll the die when it is their group's turn.
3. Each time the die is rolled, the number obtained is noted and the tiger is moved that many squares toward the group who rolled the die. For example,

GROUP 1
rolls a "3"

1	2	3	4	5	●	7	8	☒	8	7	6	5	4	3	2	1

GROUP 2
rolls a "6"

1	2	3	4	5	6	7	8	☒	8	7	●	5	4	3	2	1

GROUP 1
rolls a "1"

1	2	3	4	5	6	7	8	☒	8	●	6	5	4	3	2	1

and so on.

4. The winner is the group which succeeds in "catching the tiger," that is, on whose turn the tiger walks off their side of the Game Mat.

In most games, you will notice as you play that the tiger just keeps prowling back and forth on his "safe track." Hence, any given game could go on for a long time without anybody "catching the tiger."

Discuss with the class how the rules might be changed so that it would be easier for someone to win. Among the suggestions made will probably be the following two**:

1) Make the Game Mat shorter.
2) Let each group roll the die twice in a row on its turn.

Both of these solutions will indeed have the desired effect; in what follows we have chosen the second one so that there is no need to damage the Game Mat.

Start the game over again from the beginning using the new rule: on his or her turn, each player rolls the die twice. Here's how one such game might proceed.

GROUP 1 - FIRST ROLL: 3

1	2	3	4	5	●	7	8	☒	8	7	6	5	4	3	2	1

** If neither of these two suggestions are made, propose the second one yourself.

Before Group 1 has its second roll, ask:

T: Can you catch the tiger this time?

S: Yes.

T: What would you have to get?

S: 6.

T: Well, that could happen, but you don't have a very big chance, do you? Try anyway.

GROUP 1 - SECOND ROLL: 4

1	●	3	4	5	6	7	8	☒	8	7	6	5	4	3	2	1

GROUP 2 - FIRST ROLL: 6

1	2	3	4	5	6	7	●	☒	8	7	6	5	4	3	2	1

T: Can you catch him this time?

S: Yes.

T: What is the biggest number you can get with the die?

S: 6. (If necessary, let them check.)

T: Let's pretend you got a "6." Where would the tiger be? (Let someone show.)

So you still wouldn't be able to catch the tiger. The best you could do is have him come a bit closer. Try it.

GROUP 2 - SECOND ROLL: 2

1	2	3	4	5	6	7	8	☒	●	7	6	5	4	3	2	1

GROUP 1 - FIRST ROLL: 6

1	2	3	●	5	6	7	8	☒	8	7	6	5	4	3	2	1

T: Can you catch the tiger this time?

S: Yes, I only have to get a "4."

T: What if you got a "5"?

S: That would be OK too; and so would a "6."

T: It seems that you have a fairly good chance of winning this game.

GROUP 1 - SECOND ROLL: 5

Group 1 wins.

It is a good idea, before the die is rolled for the second time, to ask if the "rolling" group can catch the tiger. However, don't do this so frequently that it slows the game down and makes it boring.

TITLE: Strings #3

MATERIALS:

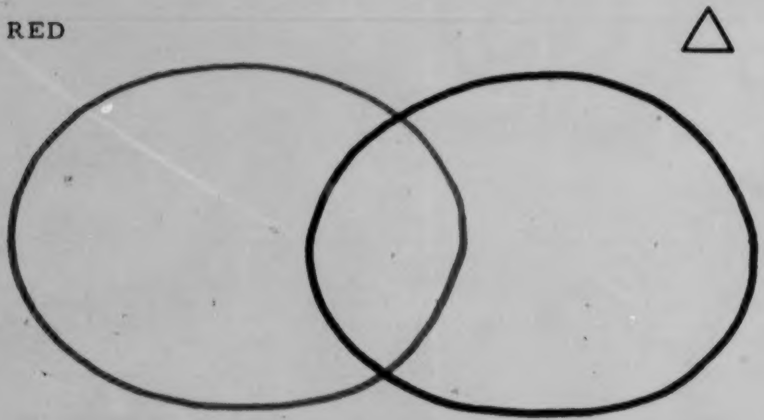
Teacher - One set of K - A blocks (see the note in Lesson K8)

Students - One set of K - A blocks per child

DESCRIPTION OF LESSON:

Activity 1:

Draw the following two strings and their labels on the board:



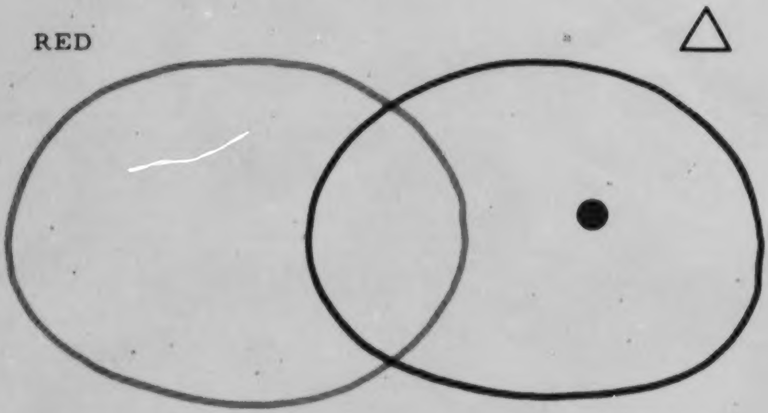
T: The yellow string is for all the red pieces.

The blue string is for all the triangles.

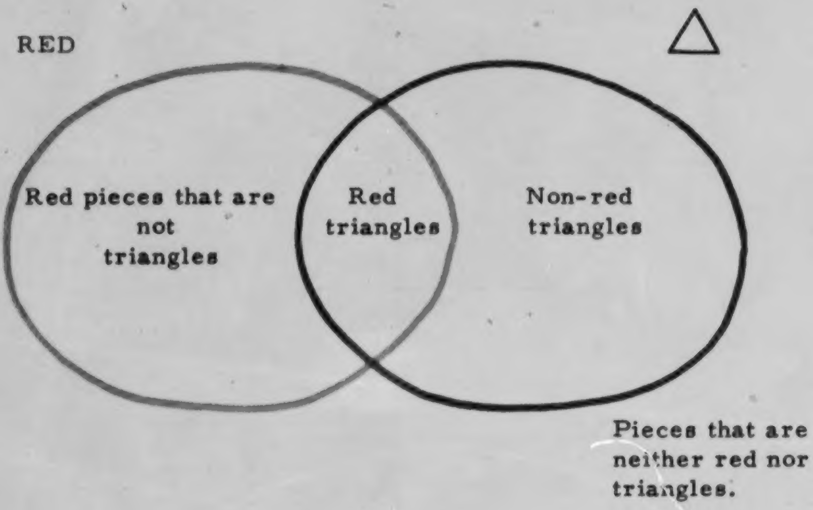
Hold up a triangle that is not red.

T: Where should I put this?

As soon as someone answers correctly, draw a dot for this non-red triangle.



Let the children take turns to come to the board, select a piece from your set and draw a dot for it in the string picture. The following diagram describes which pieces should have their dots where:


RED
△
Red pieces that are not triangles
Red triangles
Non-red triangles
Pieces that are neither red nor triangles.

HOW TO DEAL WITH MISTAKES:

The first thing to do when a child is unable to find the correct location for a piece is to make sure he or she knows what the strings are for. But even if this is not a problem, mistakes might occur, one of the most common being to misplace the dots for the pieces that belong in both strings at the same time (in this case, the red triangles).

Let's suppose therefore that a child has selected a red triangle and has not drawn the dot for it in the right region.

T: What color is your piece?

S: Red.

T: So it belongs in the yellow string. (Make a grand motion with your hand encompassing the entire area inside the yellow string.) What shape is your piece?

S: It's a triangle.

T: So it belongs in the blue string too. (Make a motion with your hand encompassing the entire area inside the blue string.)

Repeat these motions as you say:

T: So, this piece belongs in the yellow string because it is red; but it also belongs in the blue string because it's a triangle.

By now, someone in the classroom will surely know where to draw the dot for the red triangle.

Activity 2:

Distribute the students' sets of K - A blocks.

Erase the dots but leave the strings drawn on the board.

Remind your children that the yellow string is for the red pieces and the blue string is for the triangles.

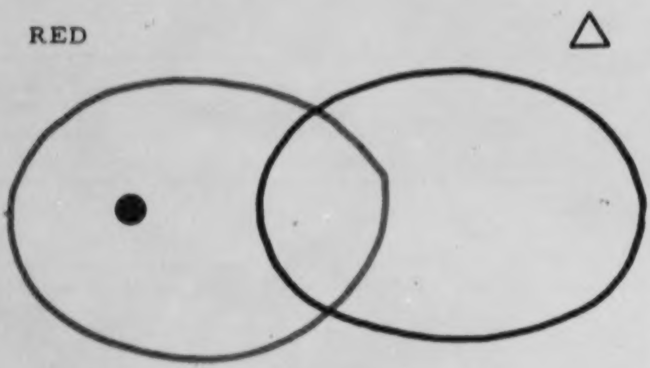
T: I am going to put a dot somewhere in this string picture. If you have a piece that this dot could be for, hold that piece up.

Do this, and wait until everyone is holding up a correct piece.

T: Could you find another piece that this dot could be for ... And yet another?

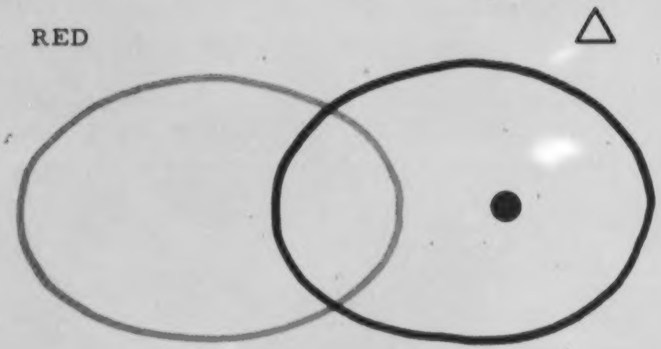
The four possible positions of your dot are shown below, together with a description of all the pieces which that dot could represent.

Position A:



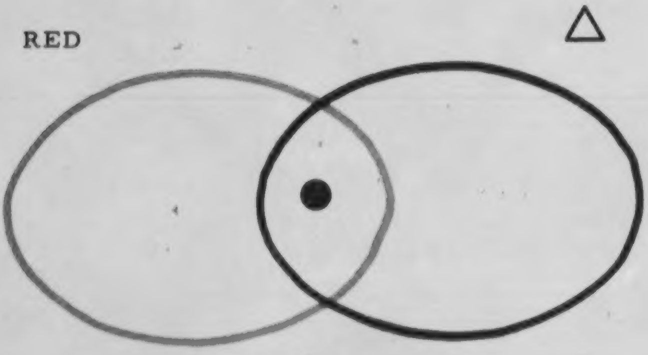
ANY RED PIECE THAT IS NOT A TRIANGLE

Position B:



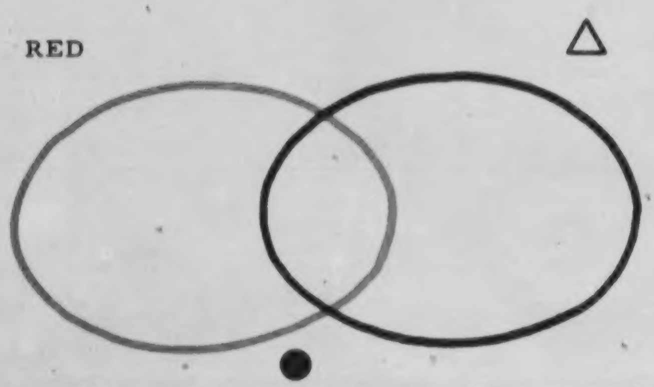
ANY TRIANGLE THAT IS NOT RED

Position C:



JUST THE RED TRIANGLES

Position D:



ANY PIECE THAT IS NEITHER RED NOR A TRIANGLE

After you have placed a dot in each of these four positions, be sure to draw a second dot in Position D and say:

T: This dot is not for one of your pieces. What could it be for? (The oldest lion at your local zoo, Mary's mother's red car, you, . . .)

TITLE: Guess My Number #2

MATERIALS:

Teacher - None

Students - None

DESCRIPTION OF LESSON:

Repeat the game which is described in Lesson K50.

You will find it useful to read that lesson over.

We suggest that, this time, you start with a rather small number, such as 12.

Variation:

To increase the children's enjoyment, you could let the student who discovers the secret number pick the next secret number (within limits; say, smaller than 50, or smaller than 100).

EARLY WARNING:

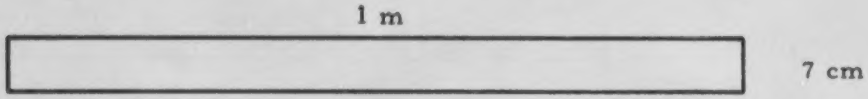
For Lesson K69 you will need to prepare some "bands" beforehand. See the lesson for details.

K69

TITLE: One Side - Two Sides #3

IMPORTANT NOTES:

1. Instructions on how to make your Moebius band and cylindrical band are given in Lesson K60.
2. In Activity 2, the strips of paper could be lengths cut from a roll of tape such as is used in cash registers.



Do not make these strips into bands by gluing the ends together. Be sure that the pens both you and the children use do not bleed through these strips of paper.

3. You might want to cut the pieces of masking tape in advance and stick four of them to the edge of each child's desk.

Activity 1:

MATERIALS:

Teacher - One large cylindrical band;* one large Moebius band;* colored pens* or magic markers* of two different colors (red and blue)

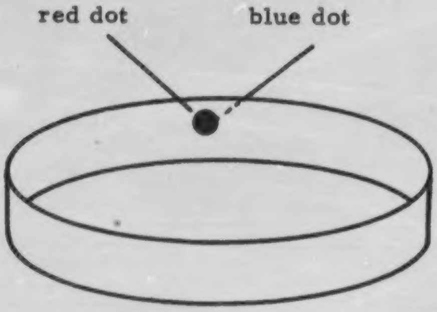
Students - None

DESCRIPTION OF ACTIVITY:

Produce your large cylindrical band.

T: On this band there live two bugs. One of them is a red bug, who lives right here. (Draw a red dot somewhere on the band.)

The other is a blue bug, who lives here. (Draw a blue dot on the other side of the band "back-to-back" with the red dot - see the picture below.)



T: The bugs can crawl around anywhere they like on the band, except that they cannot cross any of the edges. (Demonstrate what you mean with your finger.)

One day, the red bug decides to go and try to visit the blue bug. Will she ever get there?

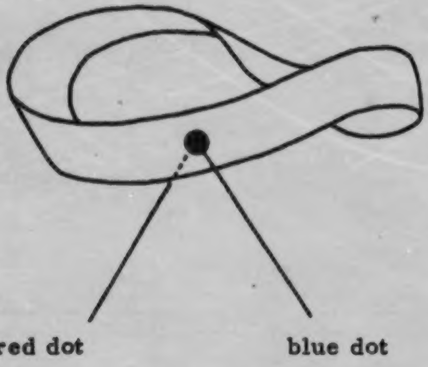
Accept whatever answer is offered, then let a child color the area where the red bug can crawl, and notice that she won't be able to visit the blue bug without crossing an edge.

T: So the red bug cannot visit the blue bug.

What about the blue bug? Can she visit the red one?

S: No. She'll have the same trouble.

Now produce your Moebius band, and explain that on this band there live two other bugs, again back-to-back.



T: Neither of these two bugs can cross the edge of the band. Can this red bug visit this blue bug?

Accept whatever answer is offered, then let a child draw a path for the red bug (it helps if you slide the band over the arm of a chair so as to have something rigid to draw on) . . . and discover that, simply by crawling along the band the red bug can indeed visit the blue one.

T: So, on this band the red bug can visit the blue one.
What about the blue bug? Can she visit the red bug?

S: Yes.

Activity 2:

MATERIALS:

Teacher - Two strips of paper;* masking tape*

Students - Two strips of paper* each; four pieces of masking tape* each; colored pen,* pencils* or crayons* (red and blue)

DESCRIPTION OF ACTIVITY:

Use two strips of paper to show the children how to make a cylindrical band and a "twisted" (i.e., Moebius) band.

Distribute strips of paper (and masking tape, if you have not done so already), and let the children try to make a cylindrical band and a Moebius band for themselves.

When they have done this, ask them to draw a blue bug and a red one "back-to-back" on each of the bands they have made, and let them check to see whether or not the bugs can visit each other.

NOTE:

> The motions required to make a Moebius band are unusual and hence not at all easy for a small child.
>
> Be ready to help!

Activity 3: (Optional)

MATERIALS:

Teacher - One or two rolls of colored ribbon;* scotch tape*

Students - None

DESCRIPTION OF ACTIVITY:

Use the colored ribbon and scotch tape to make each child a bracelet. Let the child decide if he or she wants a "regular" bracelet or a "twisted" one.

NOTE:

More activities on One Side - Two Sides are provided in the Small Group Activities in Section Four of this guide.

K70

TITLE: **Eight Elephants**

MATERIALS:

Teacher - Colored chalk*

Students - None

IMPORTANT NOTE:

During this lesson, as you move from one drawing to the next, change the position of as few of the dots as possible.

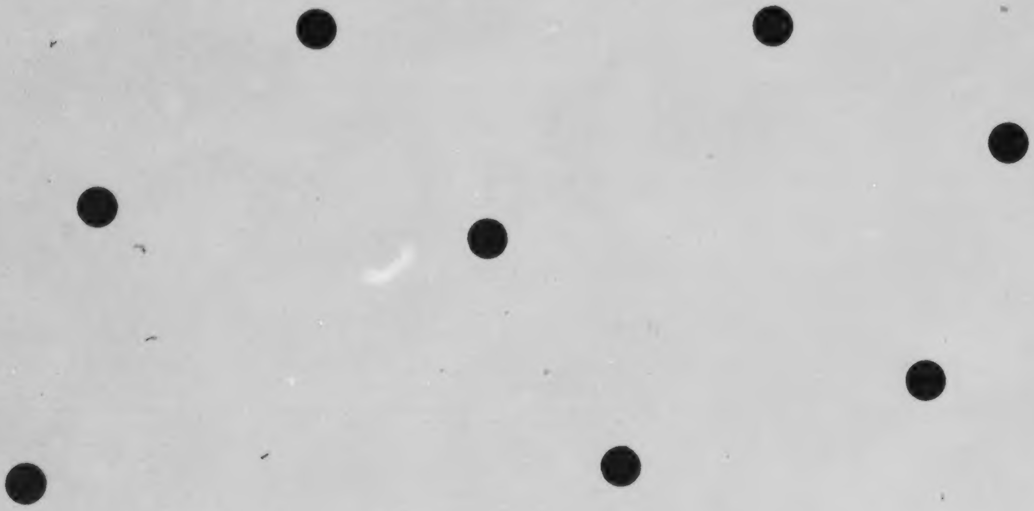
DESCRIPTION OF LESSON:

Start the lesson by having a short informal chat with your children about the circus.

T: Let's pretend we are at the circus.

Here come the elephants!

Draw eight dots on the board as follows:

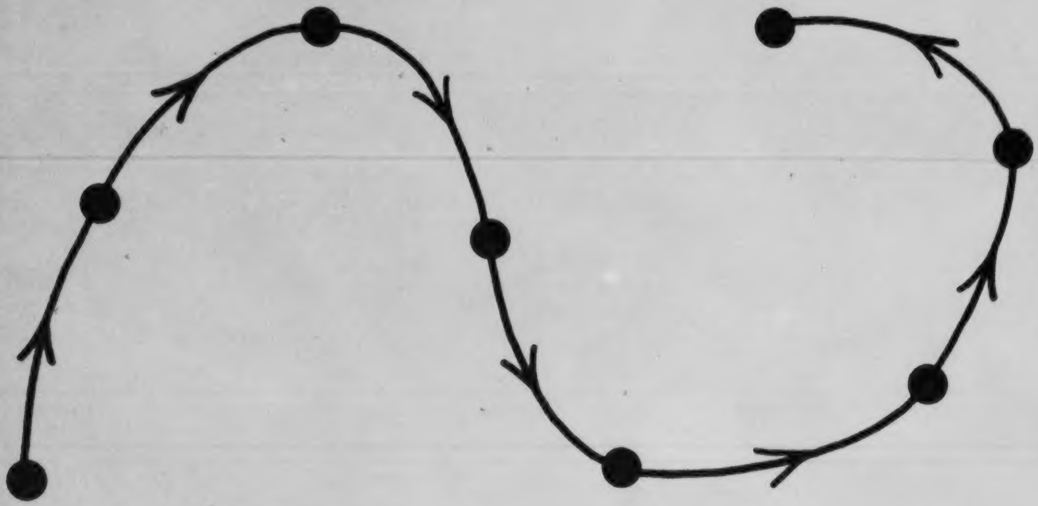


T: How many of them are there?

S: Eight.

T: They are walking one behind the other, each one using his trunk to hold on to the tail of the elephant in front.

Draw the following seven red arrows:



As you draw each arrow, say:

T: This elephant is holding on to this one's tail.

When all the arrows have been drawn ask:

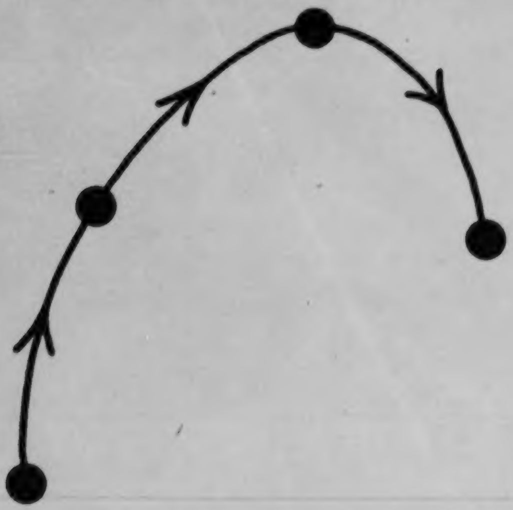
T: Which elephant is at the front of the line?

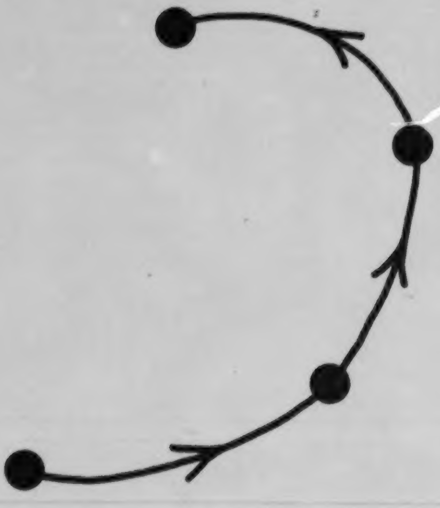
Which one is at the back of the line?

Let students come to the board and point to the first and the last dots.

T: Close your eyes.

Quickly erase one arrow:

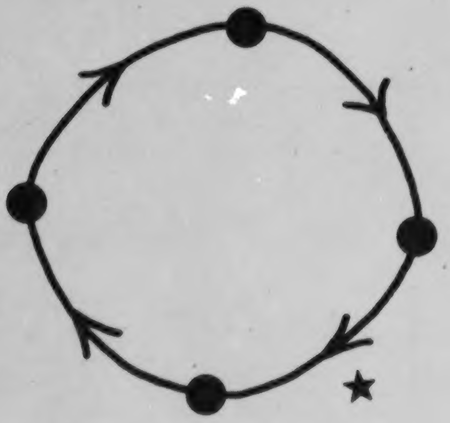


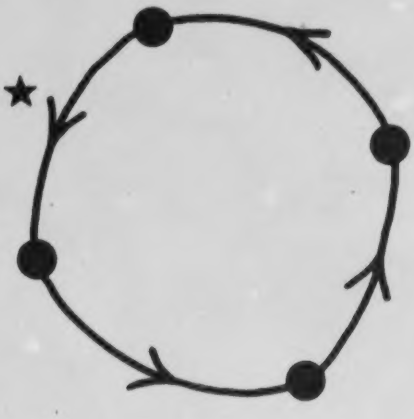


T: Open your eyes. What has happened?

S: This one lost hold of that one's tail.

Ask the students to close their eyes while you change your picture again. (The only dots you need to move are the two at the bottom of the previous picture.) Do not copy the two stars onto the board.





T: You can open your eyes now.

S: They are dancing in circles.

Clarify this child's statement in light of the meaning of the red arrows as follows:

T: You're right. Now they're walking around in two groups, holding on to each other's tails.

Trace along each of the arrows marked with a ✶, and for each one, say:

T: This elephant has changed what he was doing. Now he's holding this elephant's tail as he walks behind him.

T: How many elephants are there altogether?

S: Eight.

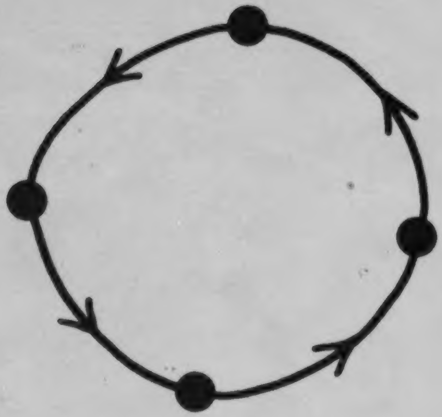
S: Right, four here, and four over there.

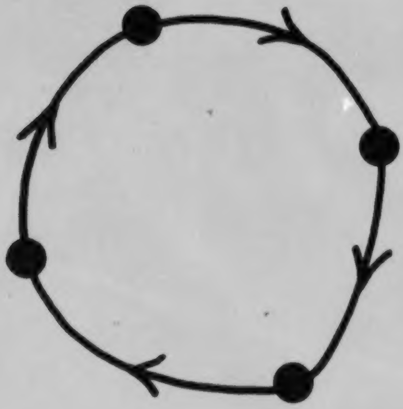
Without special comment, write the following on a second board or on a large sheet of paper:

8

4 + 4

Again, ask your students to close their eyes while you reverse the arrows.

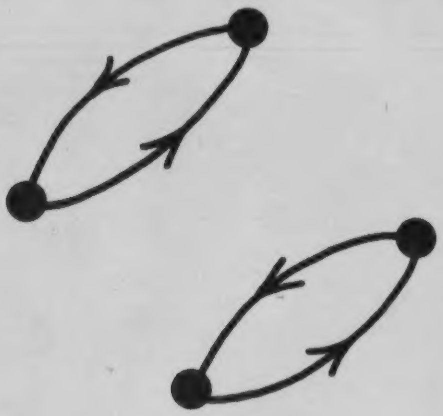


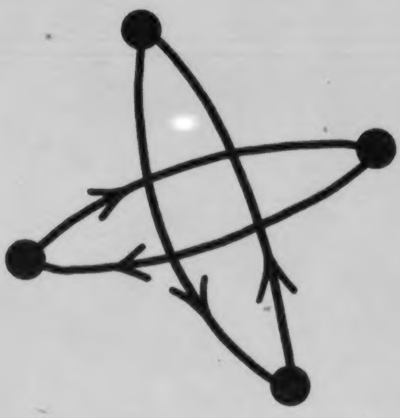


T: What has happened now?

S: They're walking the other way around.

Change your picture again:





S: Two by two.

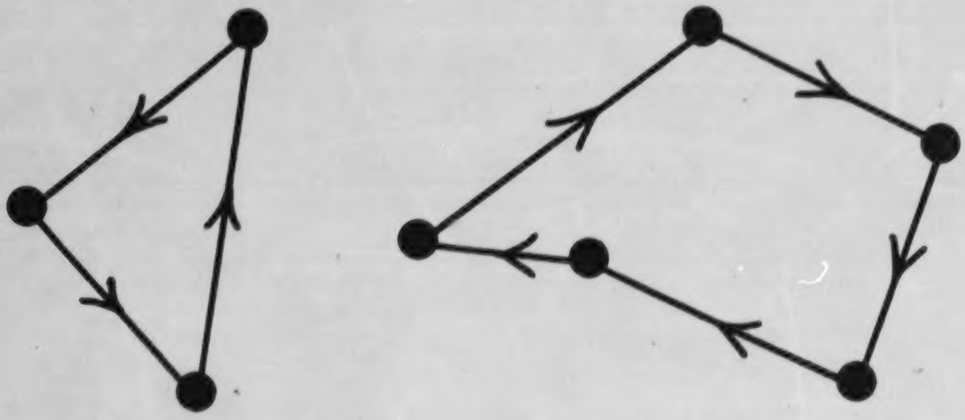
T: How many pairs are there? (Four)

K70

Again, without special comment, add the following to your record on the second board (or large sheet of paper):

$$2 + 2 + 2 + 2$$

Change the picture again (there is no need to move any of the dots):

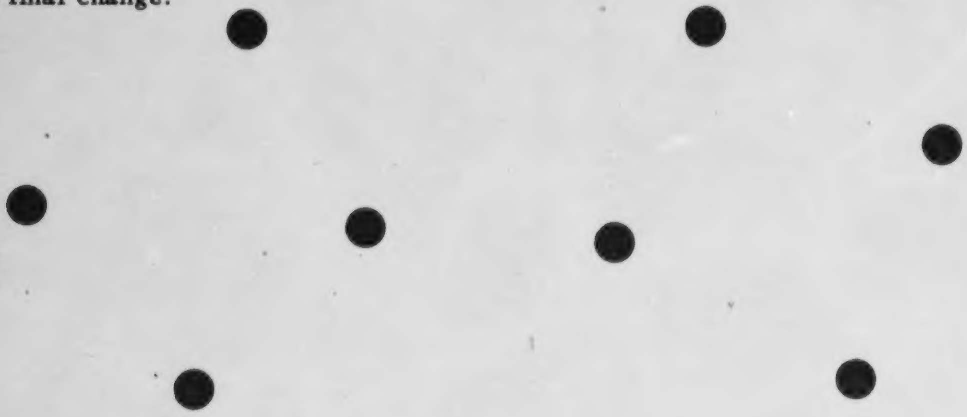


S: Five and three.

Add the following to your record:

$$5 + 3$$

A final change:



S: Each one is by himself now. They're no longer holding on to anyone else's tail.

Add the following to your record:

| + | + | + | + | + | + | + |

T: That's the end of the show.

K71

TITLE: Number Readiness #10

SUGGESTED ACTIVITIES (see the introduction to Lesson K3):

A. Don't Make a Sound

Repeat Lesson K12 (Activity A).

By this time of the year you can probably include some larger numbers.

B. Dot-to-Dot Pictures

Continue Lesson K62 (Activity B).

OPTIONAL CONTINUATION OF ACTIVITY:

If you think your children would enjoy it, you could let them color any worksheets which they complete.

EARLY WARNING:

Lesson K72 calls for a lot of string or yarn of three different colors and something (e.g., a pair of scissors) with which to cut it.

K72

TITLE: Measurement #1

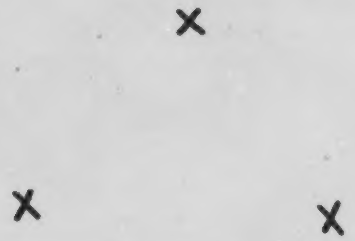
MATERIALS:

Teacher - Chalk* or masking tape;* a lot of string* or yarn* (if possible, of three colors); something (e.g., a pair of scissors*) with which to cut the string; a meterstick*

Students - None

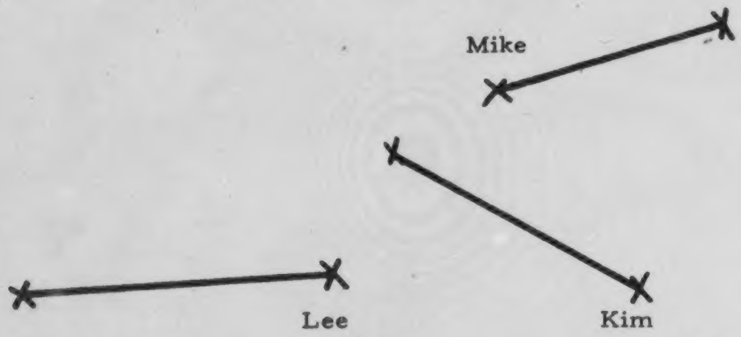
DESCRIPTION OF LESSON:

Make three marks on the floor (not in a straight line) using your chalk or masking tape.



Ask each of three children to stand on one of these marks, and then to take as big a step as he or she can (or to jump as far as possible).

Mark the distance they cover on the floor (again using chalk or masking tape).



T: Who took the biggest step?

It is unlikely that everyone will agree on a single answer.

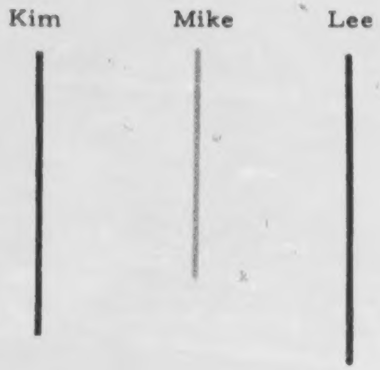
T: Some of you think Lee took the biggest step, others think it was Kim. How could we find out for sure?

Several good answers are possible at this point. Students might suggest, for example, that you should

- lay a piece of string along each step and then compare the lengths of the strings
- measure each step in hands or feet and find which step is the most hands or feet long
- measure each step with a ruler.

Perform these various measurements with the children.

It might be a good idea to start with the strings method first. Use three strings of different colors. You could tape the three strings next to each other on the board or on the floor so that the children can compare their lengths.

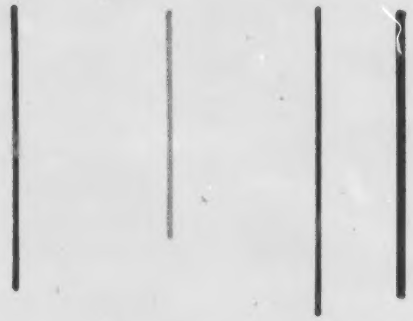


Conclude that Lee took the biggest step and Mike took the shortest one.

Then hold up your meterstick.

T: This is called a "meterstick." Do you think any of these three people took a step that is longer than my meterstick?

Let the children estimate first, then you check by laying the meterstick alongside the three strings.



As you make the comparisons, be sure to mention clearly which length has to be compared to which. For example, you could say:

T: Is the blue string longer than my meterstick?

S: Yes.

T: That means Lee took a step that is more than one meter long.

Next, stand all[*] your students in a long row and ask them to jump as far as they can or take as big a step as they can. Afterwards, find out who had the biggest step (or jump) and who had the smallest one. Then you could compare the length of the longest step (or jump) to that of the one which Lee took at the beginning of the lesson.

---

[*] If you would find it more convenient, you could divide your class into two groups for this activity: one taking steps (or jumping) while the other group helps you to measure. Then you can ask the groups to switch roles.

TITLE: Frequency Chart #1

MATERIALS:

Teacher - Colored chalk*

Students - None

DESCRIPTION OF LESSON:

T: I am going to ask you which is your favorite color: blue, red, or yellow.
Who likes blue best?
Who likes red best?
Who likes yellow best?

Let the children answer these questions by raising their hands.

T: Which color was chosen by the largest number of children?

There will probably be a fair amount of confusion about the answer to this question, and that's the whole point of this lesson.

T: How could we find out for sure?

Accept any sensible idea, such as the following:

- Count how many people voted for each color.
- Line up all the people who voted for yellow, and do the same for all those who voted for blue, and those who voted for red. See which line is the longest.
- Make a graph (if no one suggests this, do so yourself).

K73

One way of making a graph that describes this situation is as follows. Draw the following array of boxes:

●															
●															
●															

The children "vote" for a color by marking an "x" in a box in the appropriate row (each child may vote for only one color).

Let's suppose the "vote" ends like this:

●	X	X	X	X	X	X	X	X							
●	X	X	X												
●	X	X	X	X	X										

Ask various questions about this chart. For example,

T: Which color was chosen by the largest number of people?

Which color was chosen by the fewest number of people?

How many more people chose red than chose blue?

How many fewer people chose blue than chose yellow?

and so on.

T: If someone walked into the room and saw this picture while we were out at recess, what could he or she find out about our class? (For example, by counting how many "x's" there are he or she could find out how many children were in the classroom today.)

K74-1

TITLE: Detective Story #1

MATERIALS:

Teacher - A piece of paper* with the numeral "6" written on it

Students - None

DESCRIPTION OF LESSON:

T: I have a secret number friend whose name is on this piece of paper.

My friend gave me some clues to help you find out which number it is.

Here's the first clue: My number says,

CLUE 1: You will find me if you count by twos (or skip-count) from 0 to 10.

What could my number be?

Let someone skip-count from 0 to 10 while you record on the board:

0, 2, 4, 6, 8, 10

T: Here's the second clue: My number says,

CLUE 2: I am not zero.

Cross "0" off your list, then erase it.

T: Here's the third clue: My number says,

CLUE 3: I am smaller than 8.

Could it be 10? (No. Cross "10" off the list.)

Could it be 8? (No. Cross "8" off the list.)

Could it be 6? (Yes)

Ask similar questions about 4 and 2. At this point you should have the following on the board:

2, 4, 6, ~~8~~, ~~10~~

Now erase "8" and "10."

T: Can somebody tell me what my number could be?

S: 2, 4, or 6.

T: Here's the fourth clue: My number says,

CLUE 4: You cannot show me
with the fingers of one hand.

Could my number be 2? (No. Cross "2" off the list.)

Could my number be 4? (No. Cross "4" off the list.)

Could my number be 6? (Yes)

Erase "2" and "4." Now all you have left on the board is the following:

6

S: Your number is 6!

Unfold your piece of paper and show everyone that indeed you do have "6" written on it.

K74-2

TITLE: Quickie

MATERIALS:

Teacher - None

(Optional) A ball*

Students - None

NOTE:

This activity could be used as a five-minute filler at any time throughout the year.

DESCRIPTION OF LESSON:

Stand or seat the children in a circle.

Explain that you are going to indicate one student at a time and say a number. The student has to answer by saying the number that is one more.

Counting on the fingers is allowed if a child needs help during this activity.

For variety, you could indicate which student is to answer by tossing a ball to him or her as you say the number. As the student answers, he or she should toss the ball back to you.

As children become familiar with this activity, you could sometimes change the rule so that the indicated student is to respond with a number that is "one less" or "two more" or "smaller" or "larger" than your number.

K75

TITLE: Catch the Tiger #2

Repeat Lesson K66, letting each group of "hunters" toss the die twice in a row.

If you have time, play several games during this lesson.

K76

TITLE: Secrets

MATERIALS:

Teacher - Colored chalk*

Students - None

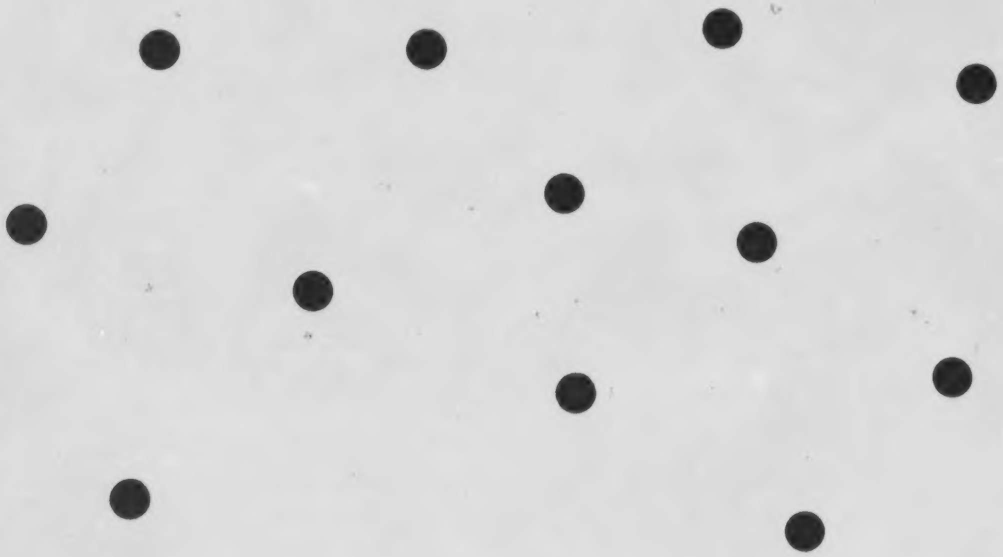
IMPORTANT NOTE:

Remember to make your drawing large, well spread out, and clear.

DESCRIPTION OF LESSON:

T: These dots are for some of the children who were in my class last year.

As you are saying this, draw 12 dots on the board as follows:

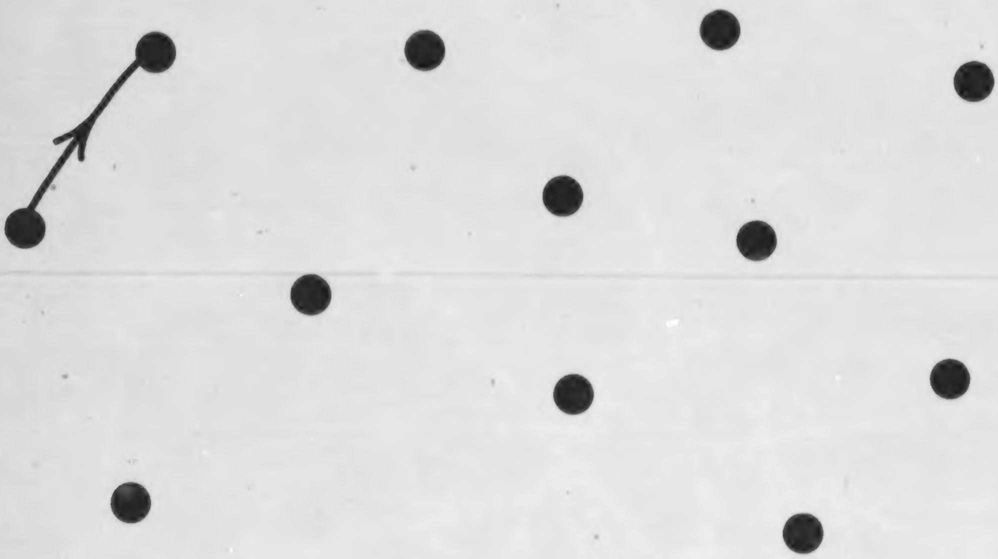


K76

Let someone count how many dots there are, point to "12" in the Numeral Row, and write "12" on the board.

T: These students loved to have secrets from each other.

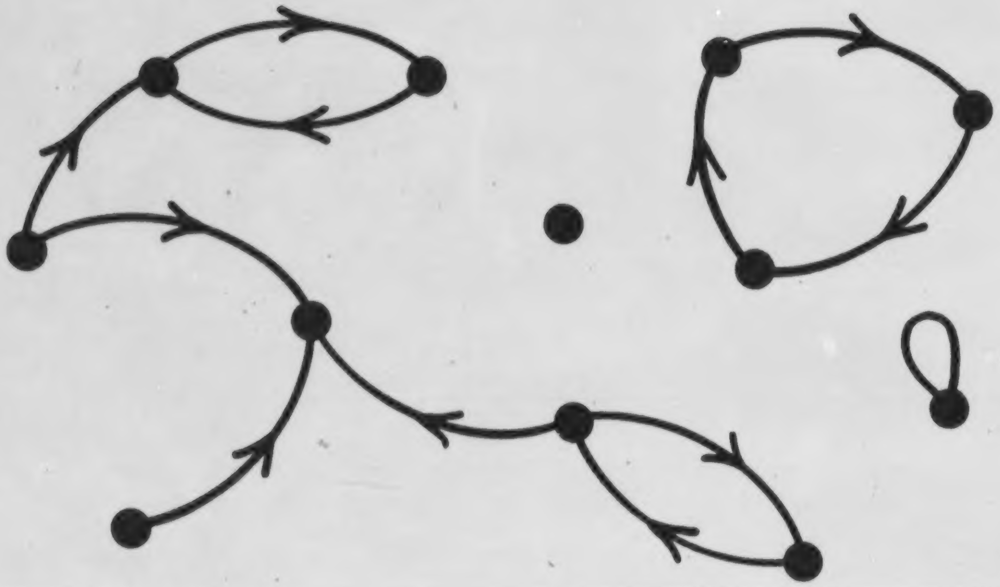
Draw one red arrow as follows:



and say:

T: This child has told a secret to this one.

Now tell the children to watch carefully, and to think about the story as you complete the arrow picture slowly. Remind them that the red arrow means: " ... has told a secret to ... "



Your students will probably have something to say about this picture without any prodding from you. Let them feel free to do this. The following are the sorts of remarks that might be offered at this point:

S: These two students have exchanged secrets.

S: That one didn't tell anybody a secret.

and so on.

After the children have said all they want to, you could choose among the following questions:

T: Which child would you like to be? Why?

Which child has told secrets to the largest number of people? (Two children have told secrets to two people.)

Which child is told the largest number of secrets?

Can you find a child who has told a secret to exactly one person, and is also told exactly one secret? Is there another child like that?

Can you find a child who has told some secrets but nobody has told him or her any? Is there another child like that?

What about this child? (Point to the dot with the loop. An explanation that might be suggested is that this child has a secret, but he's keeping it to himself.)

What about this child? (Point to the isolated dot. He hasn't told anyone a secret, and neither has anyone told him any. Maybe he didn't have any secrets to tell.)

Can you find a child who is told some secrets but didn't tell any? (There is one such child.)

EARLY WARNING:

Lesson K77 calls for a paper cup containing about 15 checkers (buttons, soda bottle caps, oyster crackers, Fruit-Loops, etc.) for each student.

TITLE: The Jumpy Frogs #1

MATERIALS:

Teacher - None

Students - A piece of paper* and a paper cup* containing about 15 checkers for each student

NOTE:

Instead of checkers, you could use buttons, soda bottle caps, oyster crackers, Fruit-Loops, etc.

DESCRIPTION OF LESSON:

Give each child a piece of paper and a paper cup containing about 15 checkers.

T: Let's pretend you are walking through a forest, and you have just come into a clearing. In the middle of the clearing there is a pond (point to one of the children's piece of paper). All around the pond, you can see lots and lots of frogs. These are the frogs (point to the checkers in one of the children's paper cup). Suddenly, four of the frogs jump into the pond.

Ask each child to take four checkers out of his or her paper cup and place them on his or her piece of paper. (As the lesson proceeds, each of your statements should be mirrored in this way by the children's placing checkers on their pieces of paper or removing them and returning them to their paper cups.)

K77

T: Then two more frogs hop into the pond.
How many frogs are in the pond now?

S: Six.

T: One of them decides to jump out again.
How many are left in the pond?

S: Five.

T: Next, two new frogs come hopping along and jump right into the pond.
Now there are ...

S: ... seven frogs in the pond.

T: Right. Now, listen carefully. Last night, two frogs hopped out of the pond, and then this morning, another one left.
How many frogs are still in the pond?

S: Four.

T: You had seven before and now there are only four.
How many frogs jumped out of the pond?

S: Three.

T: You have four frogs in your pond.
Each one has a friend who comes to visit him in the pond.
How many frogs are in the pond now?

S: Eight.

T: Two of them decide to go for a walk in the forest. That leaves ...

S: ... six frogs in the pond.

T: One half of the six frogs go away on vacation. How many frogs will that leave in the pond?

S: Three.

T: How many are going on vacation?

S: Three.

This lesson provides practice in addition and subtraction, and doubling and halving. Feel free to use the idea whenever you like.

IMPORTANT NOTE:

Save the checkers (or bottle caps, etc.). They will be called for again in Lessons K83 and K95.

EARLY WARNING:

Lesson K78 calls for a full-length mirror.

K78

TITLE: Mirror Symmetry #3

Activity 1:

MATERIALS:

Teacher - A full-length mirror*

Students - A specially-marked right hand (you could mark a red dot* on the hand or tie a colored ribbon* round the wrist)

DESCRIPTION OF ACTIVITY:

Remind the children what the word "image" means. For example, you could ask a child to stand in front of the mirror, and then remind your pupils that the "other child" in the mirror is called the "image" of the real child.

Ask everyone to raise his or her right hand.

Mark each right hand in some special way (for example, by marking a red dot on it, or by tying a ribbon around the wrist).

Now arrange the children so that they are facing each other in pairs, and ask them to play the Mirror Game. (This is described as Activity 2 in Lesson K24.)

In some classes, the students are very creative when playing this game and will produce graceful, dance-like movements. In such a case, let the children play the game as long as they like. From time to time, take advantage of the movements of a particular pair of students to point out that when a person raises his or her right arm, the "image" raises his or her left arm.

In other classes, the students might need more specific directions.

Activity 2:

MATERIALS:

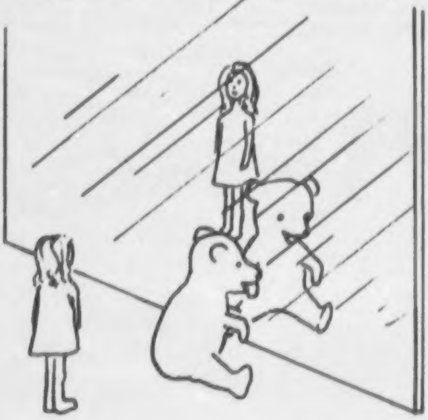
Teacher - A full-length mirror;* two fairly large objects* (e.g., a large doll and a large teddy bear)

Students - None

DESCRIPTION OF ACTIVITY:

Focus the attention of the class on the full-length mirror. (Of course, it is important that you make sure everyone can see the mirror.)

Place two objects in front of the mirror, one closer to it than the other. (For the sake of an example, let's say you are using a large doll and a large teddy bear.)



CHILDREN

With the children watching, gradually move one object (say, the doll) away from the mirror and then back toward it again.

Let the children react. It would be nice if someone noticed that the closer something is to the mirror the closer its image is.

Activity 3: The Picture in the Mirror.

MATERIALS:

Teacher - A few pocket mirrors;* (optional) masking tape*

Students - Some centimeter rods* for each child

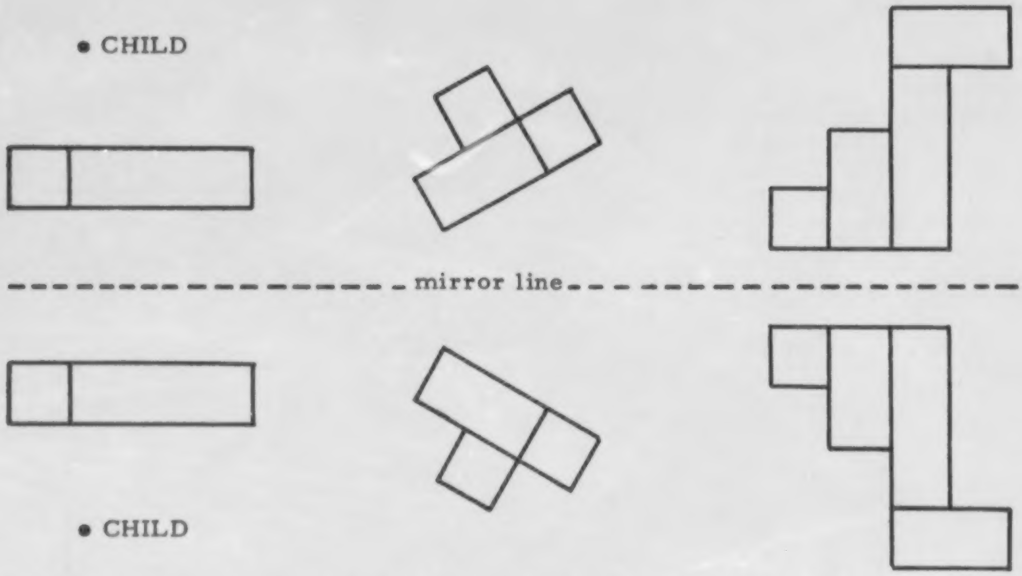
DESCRIPTION OF ACTIVITY:

Seat the children at their desks or tables so that they are facing each other in pairs.

Distribute a small number of rods (three or four to begin with) to each child. Both members of a pair should receive the same number of the same colors of rods. Of course, an alternative to this is for you to distribute full sets of rods and instruct the children only to work with three or four of them.

Between each pair of children, draw a line representing a mirror (or attach a piece of masking tape between them).

The task is as follows: The first child makes a simple construction with his or her rods. Then the second child should use his or her rods to try to produce what he or she thinks the mirror image will look like. After a while let the children switch roles.



You may wish to have available a few pocket mirrors so the children can check their work. In order for a pair of children to do this, they would have to place the mirror along the line on the desk, so that it faces the first child's construction. Make sure that both children in the pair can see both the original pattern, the second child's "mirror image" and the actual mirror image.

K79

TITLE: Strings #4

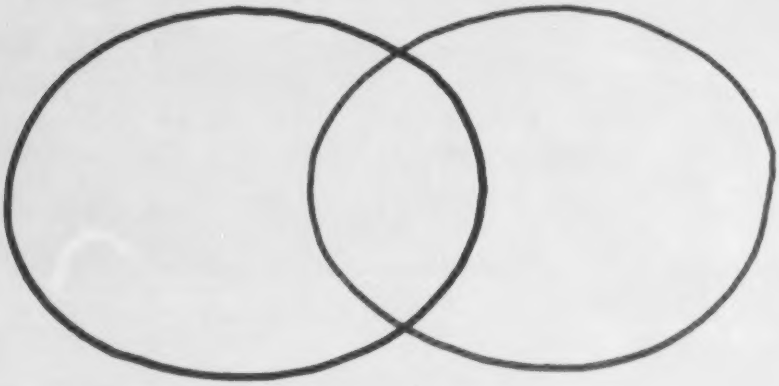
MATERIALS:

Teacher - Colored chalk*

Students - None

DESCRIPTION OF LESSON:

Draw two large overlapping strings on the board as follows:



T: The red string is for all the animals in the world with four legs. The blue string is for your pets, or the pets of people that you know. Who would like to tell us about an animal and draw a dot for it in our picture?

You certainly won't have any trouble finding volunteers! Here are some possible responses.

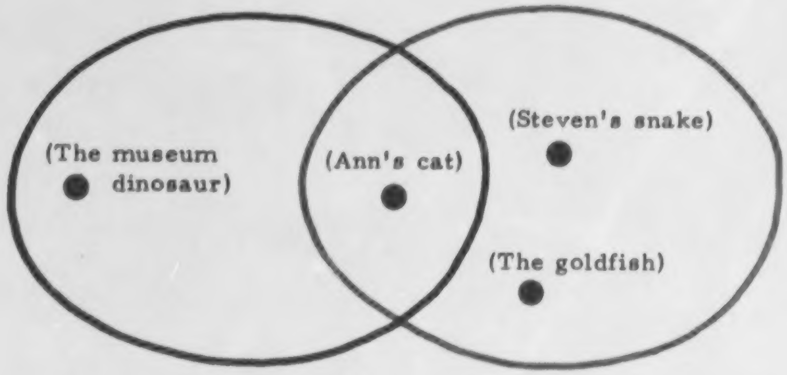
S: The dinosaur at the museum.

S: Our goldfish.

S: Steven's snake.

and so on.

By now your drawing should look something like the following:

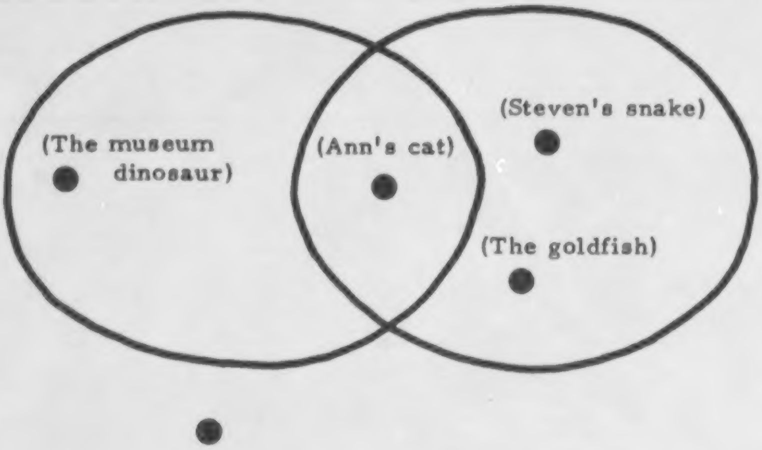


You can label the dots or not, as you like. In any case, the children will probably remember which dot is for which animal.

Try to keep your contributions to the conversation to a minimum. However, be careful to correct mistakes, and feel free to ask appropriate questions if any of the regions of the string picture have not had any dots placed in them. For example, if you were faced with the above picture, you could draw a dot outside both strings and ask:

K79

T: What could this dot be for?



S: A whale.

S: A wild snake.

S: A shell.

HOW TO DEAL WITH MISTAKES:

The first thing to do when a child suggests an animal but is unable to find the correct place to draw a dot for it is to make sure that he or she remembers what the strings are for. Even if the child knows this information, however, he or she can still make a mistake. One of the most common mistakes is to misplace a dot that belongs in the "middle" of the two strings (in this case such a dot would be for a pet with four legs).

Let's suppose a child cannot find the proper place to draw a dot for his or her dog.

T: Is your dog an animal with four legs?

S: Yes.

T: So your dog belongs in the red string. (Make a grand movement with your hand encompassing the whole area enclosed by the red string.) Now, is your dog your pet?

S: Yes.

T: So it belongs in the blue string too. (Move your hand over the whole area enclosed by the blue string.)

Repeat these motions as you say:

T: So, your dog belongs in the red string because it has four legs; it also belongs in the blue string because it's your pet.

By now someone in the classroom should know where to draw a dot for this child's dog!

EARLY WARNING:

Lesson K80 introduces the Papy Minicomputer. You might want to set up the demonstration Minicomputer boards on the magnetic board before the lesson begins.

K80

TITLE: Introduction to the Minicomputer #1

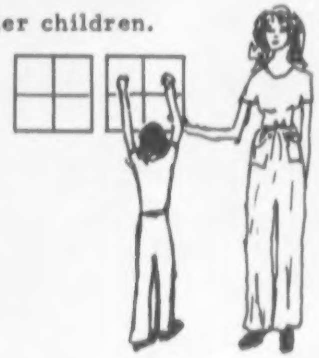
MATERIALS:

Teacher - Two demonstration Minicomputer boards (see Note #1 below); demonstration Minicomputer checkers

Students - None

IMPORTANT NOTES:

1. For all the lessons that deal with the Minicomputer you will also need to use your magnetic board. Tape your demonstration Minicomputer boards onto the magnetic board about 2cm apart. Each board should have its white square in the lower right hand corner. They should be positioned at such a height that the lower edges of the boards are at about the same level as a child's head, so that a student can be working on the Minicomputer without blocking what he or she is doing from the view of the other children.



In view of Note #4 below, and because sometimes the lessons ask you to write numerals beneath the Minicomputer boards, we suggest that, if you write on large sheets of paper taped over your magnetic board (as described in the note at the beginning of Lesson K6), you tape these sheets of paper beneath the Minicomputer boards. If you need additional writing space, tape more paper beside the boards.

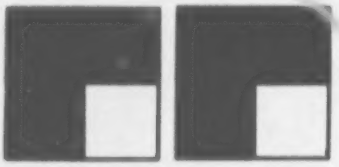
2. The whole of this first introductory lesson should be devoted to the fun of discovering the possibilities of this new tool. Let the students take you as far as they can. Don't be the least bit concerned about mastery. There will be plenty of time for review both later on in the Kindergarten program and in the First Grade program.

3. Stop the lesson as soon as your students' interest wanes. This might happen after 10 minutes, or your children might still be ready for more after 30 minutes have gone by.

4. We suggest that, in order for the Minicomputer to become a natural part of the classroom scenery, from this time on you leave the two boards permanently mounted on your magnetic board.

DESCRIPTION OF LESSON:

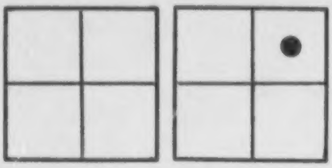
Show your children the two Minicomputer boards, mounted on your magnetic board.



K80

T: Show me four fingers. Trace a "4" on your desk. Very good! That's one way to write four. Here is another way.

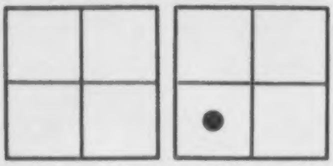
Place one checker on the purple square of the first (that is, the right hand) board:



and repeat:

T: This is 4.

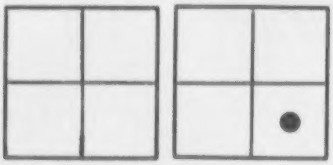
Move the checker from the purple to the red square of the first board,



and say, without further elaboration,

T: This is 2.

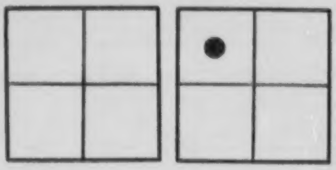
Now move the checker from the red to the white square of the first board, and say:



T: This is 1.

Go back over this to review how 4, 2, 1 are written on the Minicomputer.

Next, place the checker on the brown square, and say:



T: And this is 8.

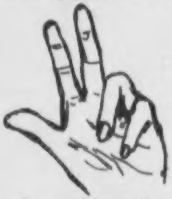
Once again, review the Minicomputer way of writing 1, 2, 4, 8.

Remove the checker.

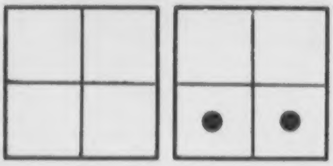
Ask the students to show you three fingers.

T: Can anyone write 3 on the Minicomputer?

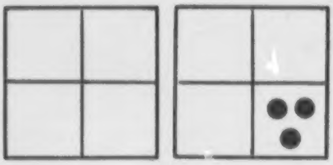
If you think your children need a hint, hold up the thumb and the first two fingers of one hand, and wiggle the two fingers and the thumb in turn.



There are two ways of writing 3 on the Minicomputer:



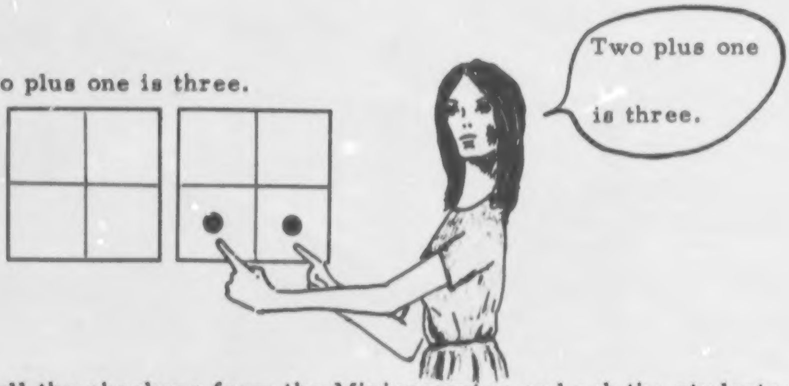
= 3



= 3

As soon as someone suggests the first way, point to the appropriate checkers and say:

T: Two plus one is three.

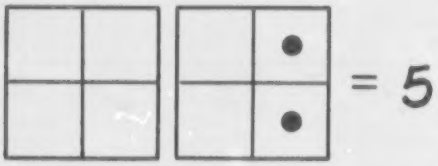

Two plus one is three.

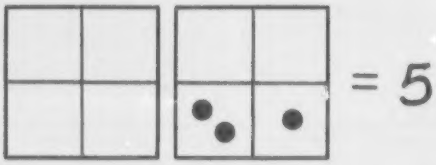
Remove all the checkers from the Minicomputer and ask the students to show you five fingers.

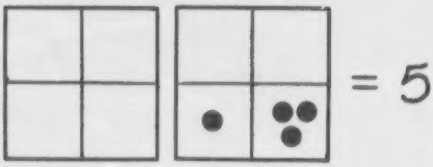
T: Who would like to write 5 on the Minicomputer?

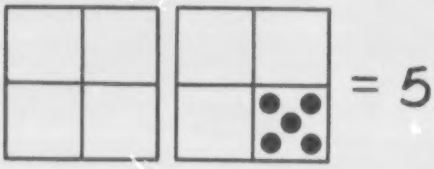
Once again, as you are asking this question, you could give a hint by holding up one of your hands and taking turns to wiggle the four fingers and the thumb.

There are several ways of writing 5 on the Minicomputer:









Accept any or all of these answers, but emphasize the first one by saying "four plus one is five."

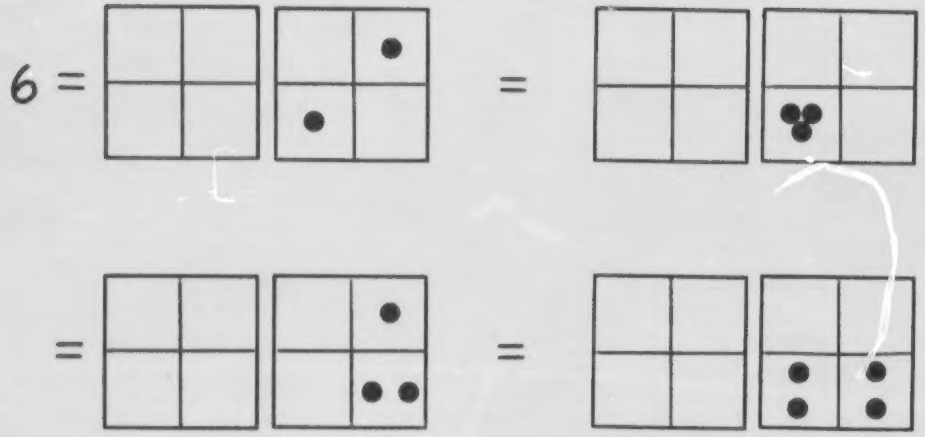
As we mentioned in Note #3 above, the students' reactions to the Minicomputer vary from one class to another. In some classes the children have difficulty concentrating on it for a full period. If this is what is happening in your class, you could end the lesson at any time from now on. If you do this, quickly review the Minicomputer writing for 1, 2, 4, 8 and then use the remainder of the period for a short numerical activity.

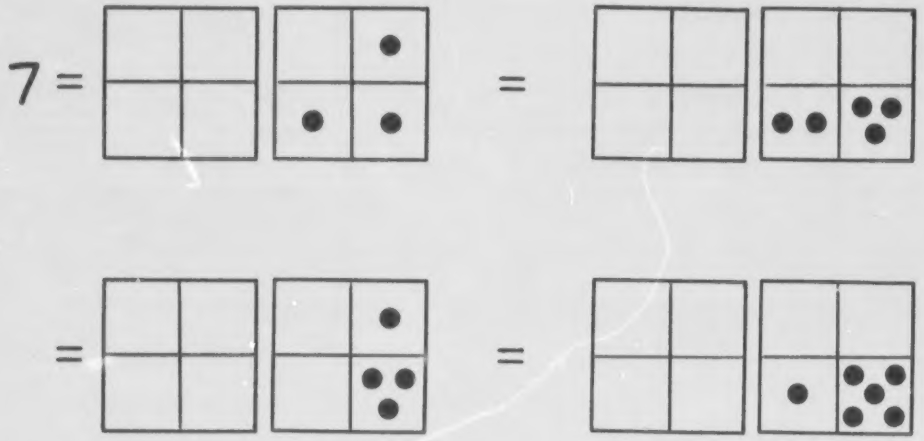
In other classes, the children are so enthusiastic about this new tool that they can concentrate on it for a surprisingly long time. If this describes your class, just keep going and ask if anyone can write 6, 7, 8, 9 on the Minicomputer.

Encourage your class to find several different ways of writing each number. This is possible, since there are several correct answers in each case.

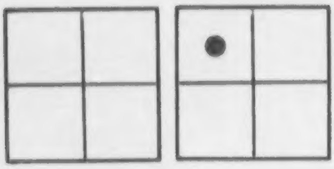
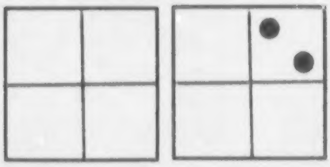
K80

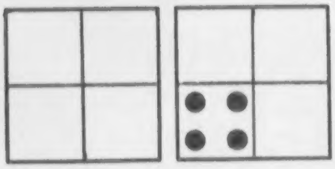
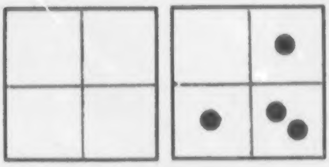
We show some of these answers below[**]:





[**] In each case, the first answer given is the "standard configuration."

8 =  = 

=  = 

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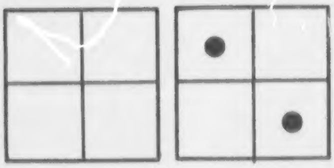
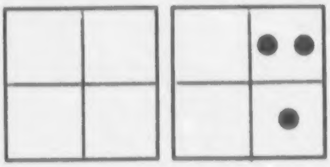
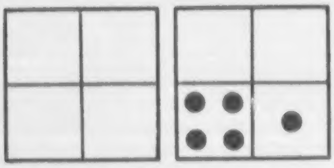
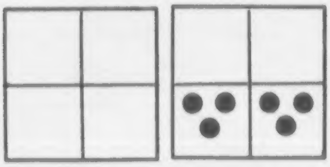
9 =  = 

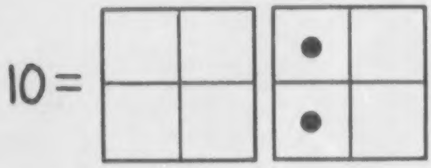
=  = 

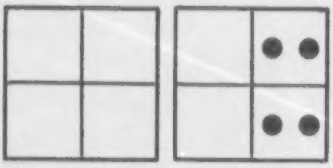
If time, energy and interest permit, you could now proceed as follows:

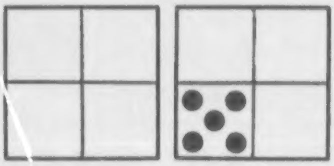
T: Can anyone show 10?

K80

The most common answers will be:

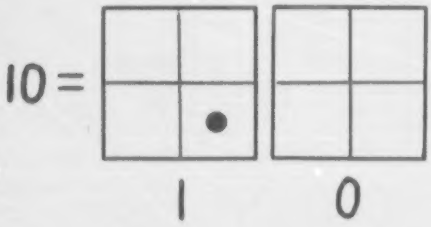






but others are possible.

Stress that, although these are correct ways to make 10, there is a way to make 10 that uses only one checker. Immediately place a single checker on the white square of the second (that is, the left hand) board, and write "10" underneath the Minicomputer with the digits lined up under the appropriate boards.

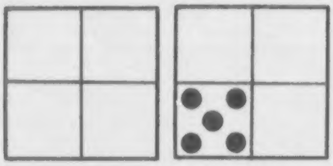


Don't forget that you can stop this lesson at any time. Before you do, quickly review the Minicomputer way of writing 1, 2, 4, 8.

HOW TO CHECK AN ANSWER WITH THE CHILDREN:

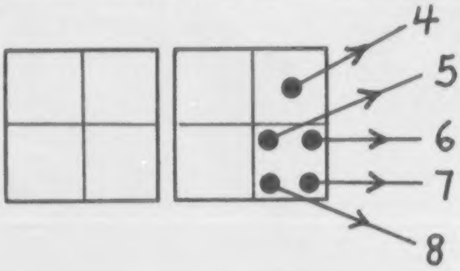
There is no unique way of checking an answer on the Minicomputer with the children. Below, we illustrate some of the possible techniques. Try to choose the one that is most appropriate for the kind of answer you are attempting to check. (This choice will become easier to make as you become more familiar with the Minicomputer.) There is, however, one rule of thumb: whenever there are several checkers on the board, it almost always helps to single them out one by one. Either you can point to them one by one, or you can mask all the checkers with a sheet of paper and uncover them one by one.

Technique 1: Counting.



This is a tailor-made opportunity to count by twos!

Counting would also be very useful in the following example:

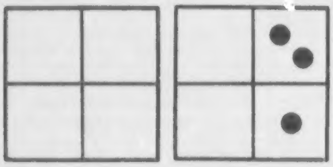


K80

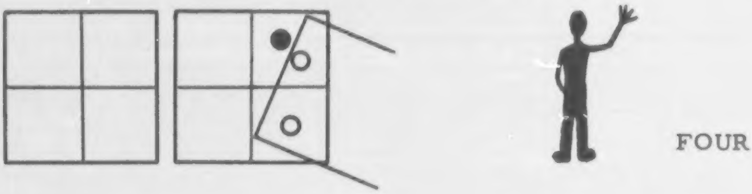
Point to each checker in turn (start with the one that is for the biggest number - in this case, 4) and ask the children to count along with you.

Technique 2: Fingers.

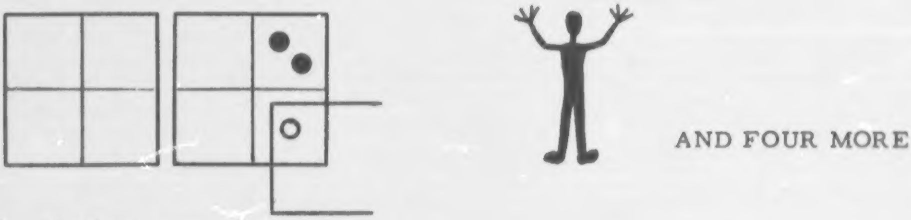
Mask the checkers with a piece of paper and then uncover them one at a time, while the children show the appropriate number of fingers. For instance, to check that



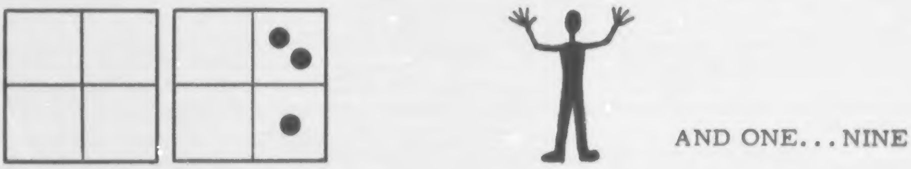
really does show 9, you could uncover a first checker:



then a second:



and finally, the last one:



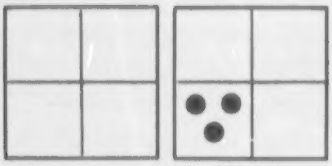
HOW TO DEAL WITH MISTAKES:

In a "learn and discover by doing" approach such as this, mistakes are inevitable, in fact, they are a very important part of the learning experience.

Here are some ways in which you can cope effectively with the most common ones.

I. Correct Answer to the Wrong Problem.

Situation: You ask the children to write 5 on the Minicomputer and someone suggests:

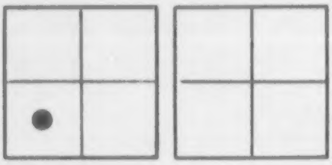


Let the students check this answer (as described above) and discover that in fact this is a way to write 6.

T: Good. We've just found a way to write 6. Can someone find a way to write 5?

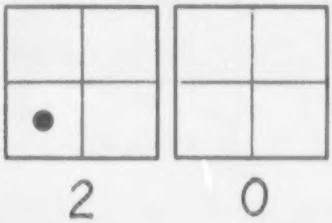
II. Wrong Board.

Situation: You ask the class to write 2, and a student answers:

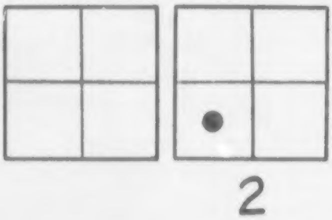


K80

This is a fruitful mistake! Without making a big issue out of it, clarify the fact that this is not 2 but 20. (Write "20" underneath the Minicomputer.)



Remind the children that 2 is on the first board:



On the next two pages we provide you with some information about the Minicomputer to which you can refer in later lessons.

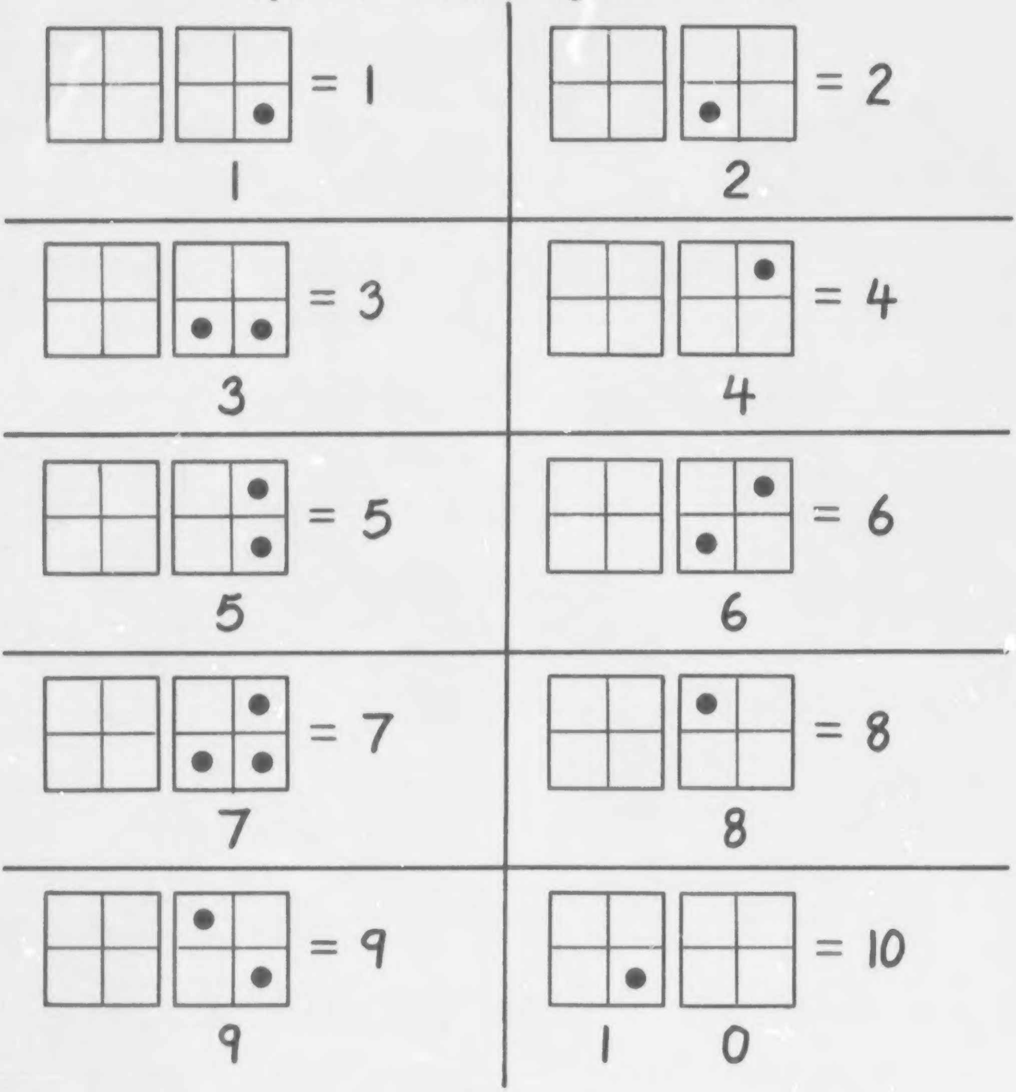
EARLY WARNING:

Lesson K81 calls for the small doll you used with Lessons K19 and K33.

MINICOMPUTER GLOSSARY
(For Teacher's Information Only)

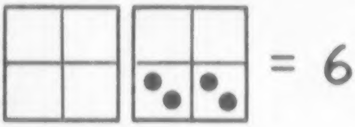
STANDARD REPRESENTATIONS OF THE NUMBERS 1-10 ON THE MINICOMPUTER

(Each board is oriented so that the white square is in the lower right hand corner.)


= 1
1
= 2
2
= 3
3
= 4
4
= 5
5
= 6
6
= 7
7
= 8
8
= 9
9
= 10
1 0

OTHER REPRESENTATIONS

Other representations of these numbers are possible and will be encouraged in later lessons. For numbers smaller than 16, the nonstandard representations require at least as many checkers as the standard ones. For example,



TITLE: Robot Walk #3

MATERIALS:

Teacher - A copy of the Robot Walk Grid (see the note at the beginning of Lesson K19); one red checker; a small doll* (a robot, a fireman, or a policeman, etc.).

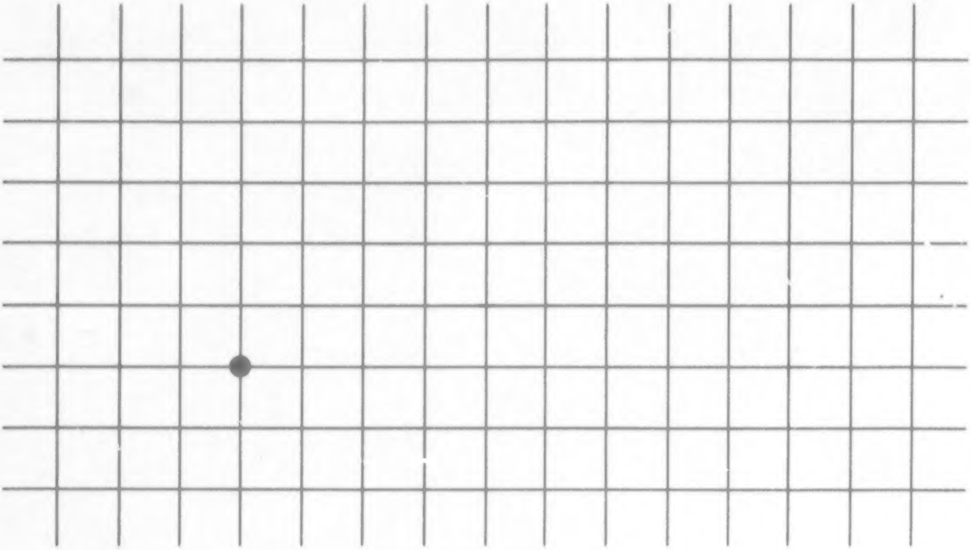
Students - None

DESCRIPTION OF LESSON:

Set up your class in the same way as you did in Lesson K19, and remind the children of the rules which were explained on the occasion of that lesson.

Activity 1:

Place the robot on an intersection.



Choose one child to be the robot operator. Give the directions to the operator yourself, all at one time.

As in previous lessons, phrase your directions as follows:

Forward two steps

Turn to the window[*]

Back one step

The robot operator's job is first to listen, and then to carry out the directions. If he or she makes a mistake, repeat the directions one by one, thus providing a chance for the mistake to be corrected.

As in previous lessons, when such a mistake is made, the whole class should protest silently (by raising both hands, for instance).

Activity 2:

This is the same as Activity 1, except that this time one child operates the robot, while another one gives the directions, again all at once. (You might want to place an upper limit on the number of directions that can be given.)

As in Lesson K19, directions which, if obeyed, would send the robot off the portion of the grid which you have displayed are illegal. As suggested in Lesson K19, when a child gives such a direction

- the whole class should be encouraged to protest (by raising both hands, for example)
- the robot ignores it, and

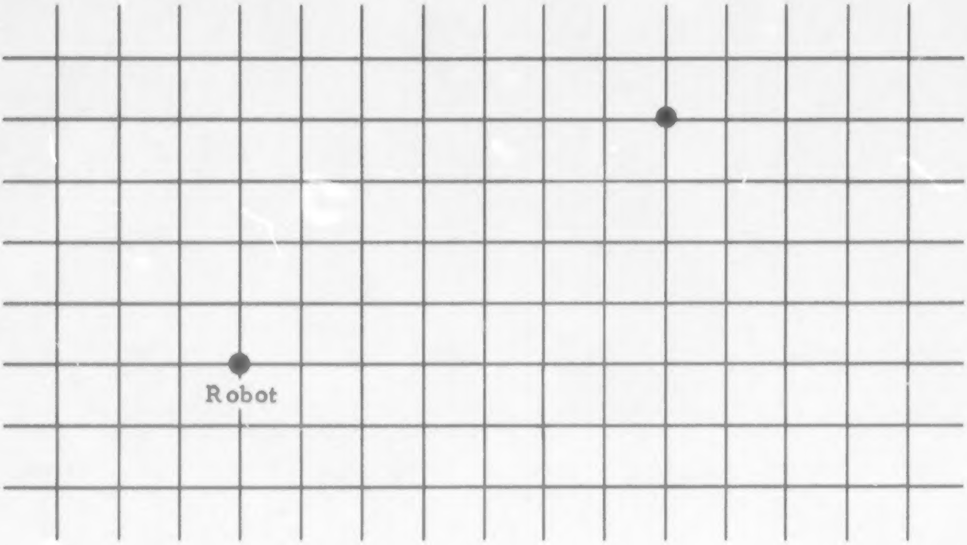
---

[*] As in Lesson K19, do not give commands such as "turn to the right" or "turn to the left."

- the child who gave the direction has to pass on the responsibility for giving directions to someone else.

Activity 3:

Place the robot on one intersection, and a red checker on another.



One child is the robot operator while another child gives the directions, again all at once.

The idea is for the robot somehow or other to reach the colored checker, not necessarily by one of the shortest ways, however. (You might explain that the second child is at the place indicated by the red checker, and he or she is calling the robot on the phone, trying to explain how the robot can find him or her.) Since there are many ways for the robot to achieve this goal, when one way has been found you could ask two other children to start over again and find another way.

K82

TITLE: The Talking Numbers

MATERIALS:

Teacher - Colored chalk*

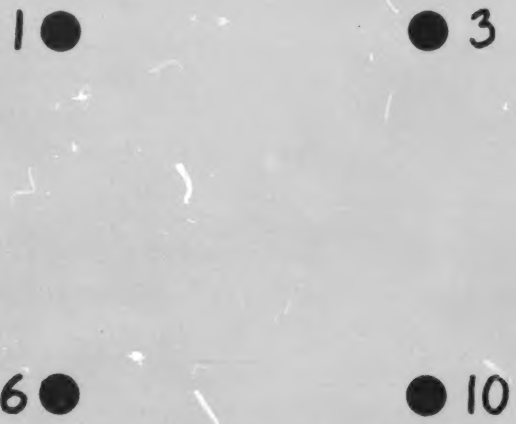
Students - None

IMPORTANT NOTE:

Even though this lesson only involves four dots, that should be all the more reason for you to spread them a long way apart, making a very clear, attractive drawing.

DESCRIPTION OF LESSON:

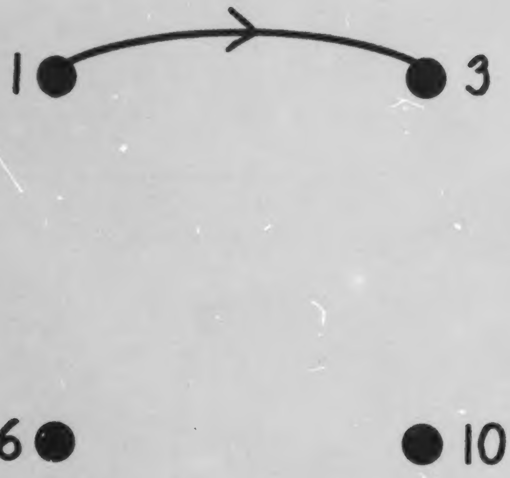
Start telling the following story, and as you do so, draw four labeled dots on the board, as follows:



T: One day the numbers 1, 3, 6, and 10 met each other. The number 1 looked at 3 and said . . . what do you think it is going to say: "I am smaller than you" or "I am larger than you"?

S: "I am smaller than you."

Draw a red arrow as follows:

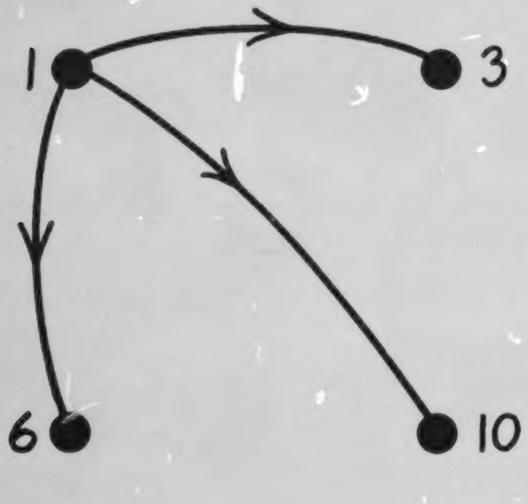


As you do this, repeat,

T: One is smaller than three.

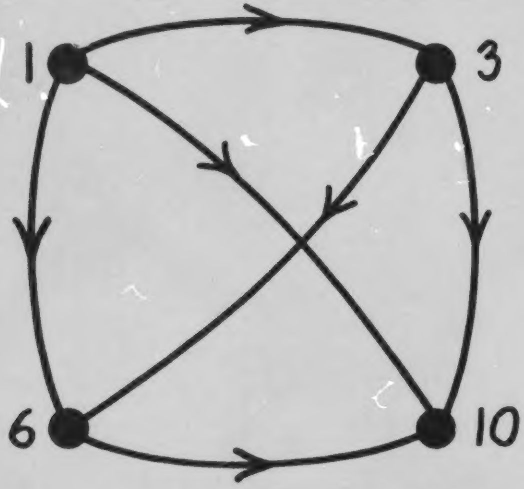
Can the number 1 say "I am smaller than you" to any of the other numbers?

Let the students trace the other two possible arrows, but draw them yourself.



T: What about the other numbers? Can any of them speak to each other in red?

The following is the complete arrow picture for " ... is smaller than ... " among these four numbers. It might take some time - and a fair amount of assistance from you - for your students to find all the arrows.



T: Now look at the picture. Which number did the most talking? (1)

How do you know? (Three arrows start from his dot.)

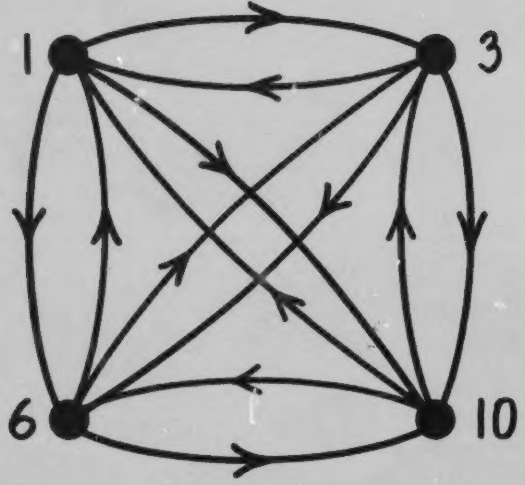
Which number doesn't have anything to say? (10)

Can you imagine a game in which 10 could talk to the other three numbers?

S: "I am larger than you."

Let various children come to the board and trace arrows for "I am larger than you." Draw these arrows in some color other than red.

The complete arrow picture for " ... is larger than ... " is drawn in blue in the following diagram:



When all the arrows have been found, ask the students if they notice anything. Of course, many answers are possible. Two of the most interesting are:

S: Each time you have a red arrow there is a blue one too.

S: In the second game, 10 does most of the talking and 1 has to listen all the time.

EARLY WARNING

Lesson K83 calls for numeral cards (or bingo or lotto checkers). It also calls for a box full of checkers, buttons (or bottle caps, etc.) for each student.

K83

TITLE: Number Readiness #11

SUGGESTED ACTIVITIES (see the introduction to Lesson K3):

A. Movie Theater #1

MATERIALS:

Teacher - Colored chalk;* numeral cards* from 11 to 49 inclusive, with the exception of 20, 30, 40 (see the note below)

Students - None

IMPORTANT NOTE:

CSMP provides Demonstration Numeral Cards which cover the range 0-30. So for this activity you will need to obtain (or make) some other numeral cards. For this purpose, you could use any commercially available numeral cards, or else bingo or lotto checkers. Whatever you use, retain them after the lesson because they will be used again in Lesson K97.

DESCRIPTION OF ACTIVITY:

Write the following array of numerals on the board:

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49

Explain to the children that this is the plan of a movie theater. The seats are numbered. The red numerals show which places are already occupied.

Give a numeral card to each child. The children should then take turns to read their cards and take their seats on the theater plan by crossing out the appropriate numerals. For instance:

T: Mary what is your seat number?

Mary: 34.

Mary comes up to the board and crosses out "~~34~~."

T: Look! You are in the same row as seat number 30 and in the same column as seat number 4.

After a few examples like this the children should start making this kind of comment of their own accord.

To end this activity you could ask someone to read the black numerals that have not been crossed out (they are the seats which remain unoccupied).

Keep the numeral cards you used during this activity. You will find them useful again in Lesson K97.

B. Two by Two

MATERIALS:

Teacher - None

Students - A box full of checkers, or buttons,* or bottle caps,* etc. for each student

DESCRIPTION OF ACTIVITY:

Ask each student to select 11 checkers (or buttons or caps, etc.) from his or her collection.

T: These checkers stand for the students in a certain class. When they go to gym (P. E., playground, etc.) they are supposed to walk two by two. What do you think is going to happen?

Let the children say what they think, then check by actually arranging the checkers in rows of two. They should notice one child doesn't have a partner.

Do a similar exercise with 14, 18, 19, 21 checkers.** Each time, BEFORE actually moving the checkers, ask the students if they think everyone will have a partner.

**Modify these numbers according to the ability of your students.

EARLY WARNING:

Lesson K84 calls for a meterstick and some yarn or string.

TITLE: Measurement #2

MATERIALS:

Teacher - A meterstick;* string* or yarn*

Students - None

DESCRIPTION OF LESSON:

Activity 1:

Hold up your meterstick, remind the students what it is called and recall the day when Lee (whoever it was in your class) took a step that was longer than one meter. (This took place during Lesson K72: Measurement #1.)

T: Look around the room and see if you can spot something that is shorter than one meter. Don't say anything yet.

There are several ways to proceed from this point:

1. You could ask one child to go fetch the item he or she has in mind (or stand next to it if it is immovable or too heavy).
2. You could ask several children to do this.
3. You could let the whole group walk around the room to locate their items.

Check a suggestion with your meterstick only if it is necessary. If you ask questions or make statements, remember to form complete sentences which indicate clearly what is being compared to what. For instance,

"Is the chalk tray shorter than one meter?"

or

"The meterstick is a lot shorter than the chalk tray."

Next, ask the children to locate something that is about as long as your meterstick, and proceed as above. Finally, do a similar exercise in which the children are to look for something that is longer than your meterstick.

Activity 2:

T: Look at the bottom edge of the bulletin board.[*] Is it longer than one meter or is it shorter than one meter?

Run your finger along the edge you have in mind.

S: It is much longer.

T: Let's find out how many metersticks long this edge of the bulletin board is.

In all likelihood, the answer will not be a whole number. Conclude that the bulletin board is (say) BETWEEN 2m and 3m long.

Activity 3:

T: Karen. (Choose a student in your class.) Do you think you are shorter than one meter or taller than one meter?

---

[*] Feel free to substitute any object that is suitably long (that is, several meters long).

This could lead to an enjoyable activity, namely the determination of which members of the class are taller than one meter, and which are shorter.

Activity 4:

T: Do you know anyone who is a lot shorter than one meter?

S: My baby sister.

T: Do you know anyone who is taller than one meter?

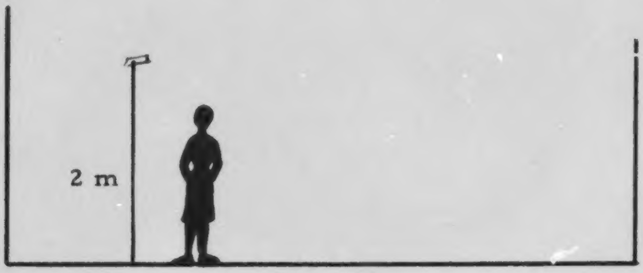
S: Me.

T: Let's cut a piece of string so that it is exactly twice as long as my meterstick.

Attach this string in a vertical position to a wall. The lower end of the piece of string should be touching the floor. (See the picture below.)

T: Am I taller than two meters?

S: No.



T: Do you know anyone who is taller than this? (Point to the 2m piece of string.)

K84

A human being more than 2m tall is a rarity.[*] So it is unlikely that the children will know anyone to fit this description. Nevertheless, they will probably still volunteer some answers.

S: My dad.

Give such a student a piece of string that is 2m long, and tell him or her to check whether or not he or she is right that evening.

IMPORTANT NOTE:

> Remember to use your meterstick whenever you are in a situation where it is natural to measure something.

---

[*] Some very tall basketball players are more than 2m tall. So are certain animals, such as giraffes and elephants.

TITLE: Permutations #2

MATERIALS:

Teacher - Colored chalk*

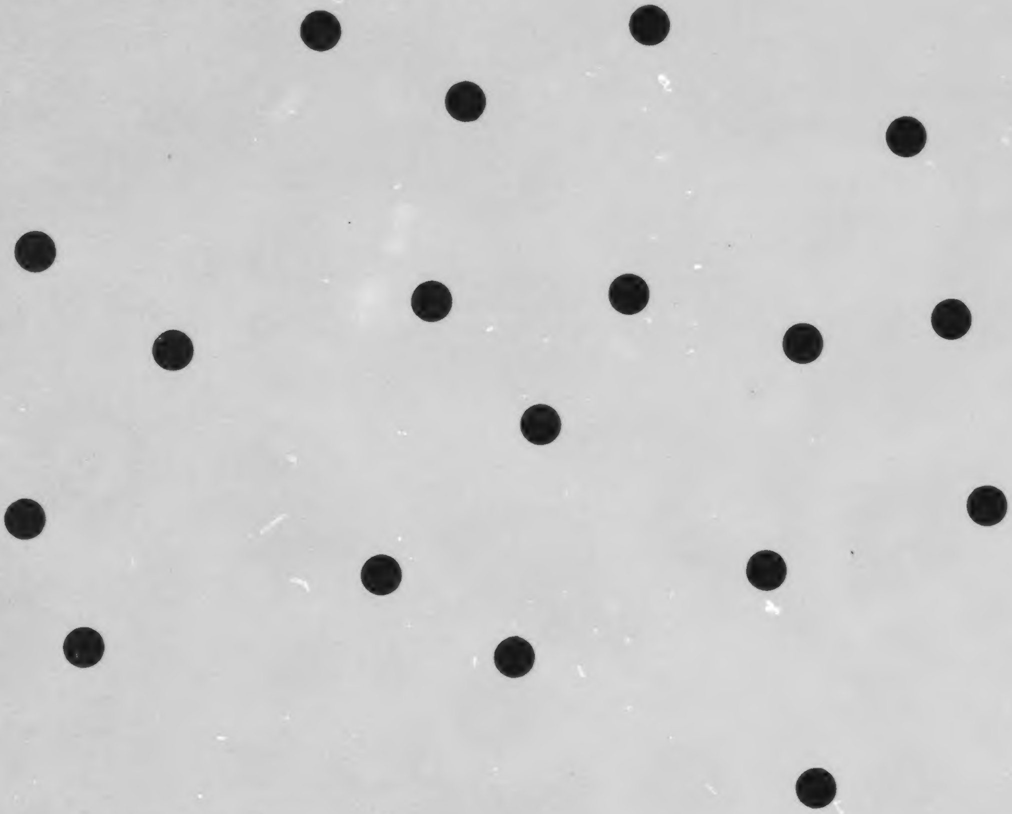
Students - None

IMPORTANT NOTE:

Remember to draw big dots, to spread them far apart on your board, and to draw long, clearly visible arrows.

DESCRIPTION OF LESSON:

Draw 18 dots on the board as follows:



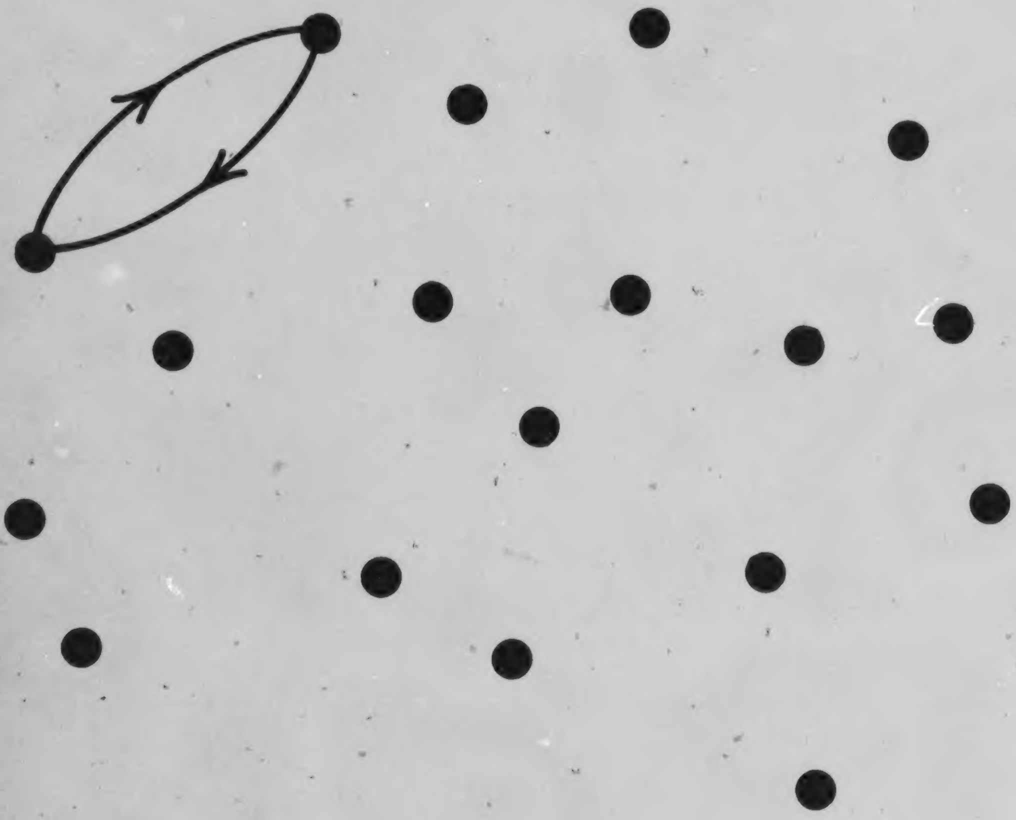
K85

If you wanted to, you could ask the children to count the dots as you draw them.

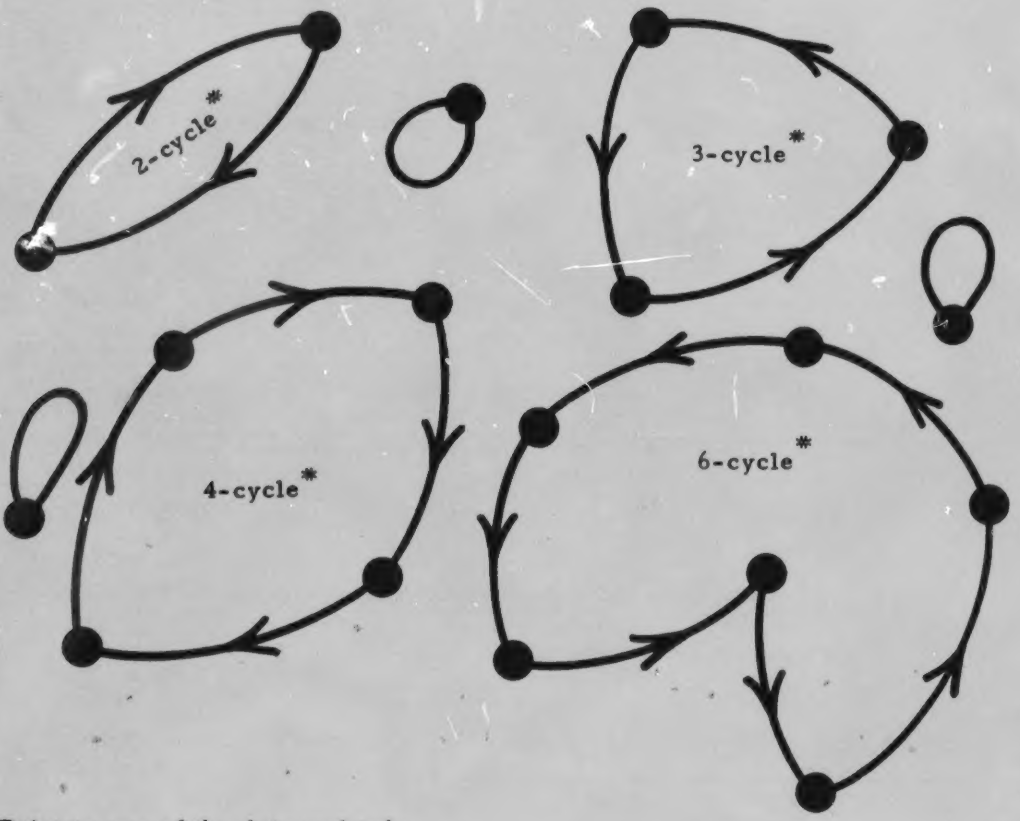
T: These dots are for stools (or chairs), and each of these stools has someone sitting on it. The children who are sitting on the stools have decided to change places.

Draw the following two arrows and say:

T: The child who is sitting on this stool went over and sat on that one, and the child on this stool came over here.



Then complete the arrow picture.



Point to one of the dots and ask:

T: Where does the child on this stool go?

or

Which stool does the child who ends up on this stool come from?

Ask these questions about every two or three dots.

Go on to ask:[**]

---

[*] Don't write this on the board.

[**] From this point on, stop the lesson as soon as your students lose interest.

K85

T (pointing to one of the four cycles): How many children changed places here?

T (pointing to a dot with a loop): What about the child on this stool?

S: He just sat still the whole time.

T: Are there any other children like him in my story? (Yes, two others)

T: These children changed seats several times according to this picture. Where will the child who started out on this stool (point to a dot in the 4-cycle) be after two moves?

You could let a student come up and indicate where he or she thinks the child will be, and then check his or her answer by following the arrows.

T (pointing to a dot in the 6-cycle): Where will the child who started out on this stool be after three moves?

(pointing to a dot in the 3-cycle): Where will the child who started out on this stool be after five moves?

(pointing to a dot in the 6-cycle): Where will the child who started out on this stool be after ten moves?

(pointing to a dot in the 3-cycle): Where will the child who started out on this stool be after three moves?

What do you notice?

S: He is back on his original seat again.

T (point to a dot in the 2-cycle): After how many moves will the child on this stool be back on the same stool again?

S: Two moves.

T: Where will he be after four moves?

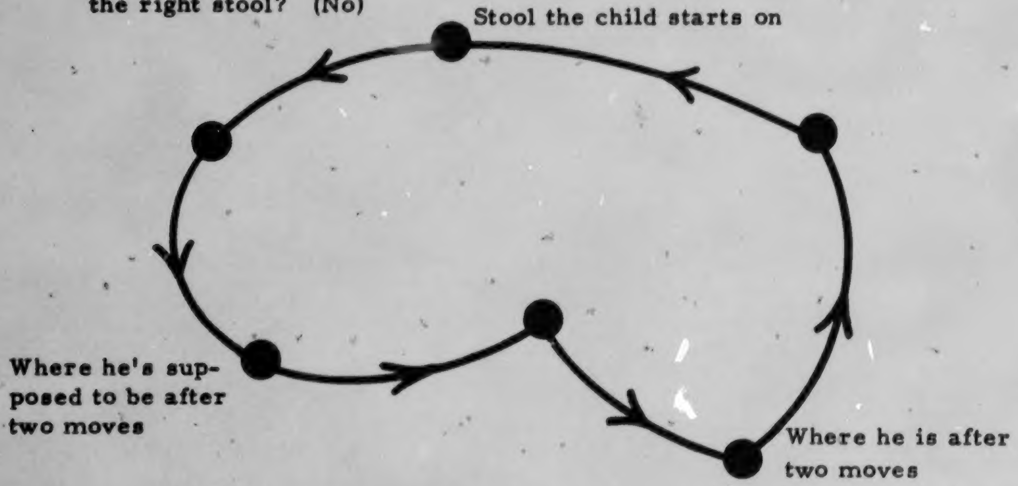
S: Back on the same stool again.

T: Will any other children be back on their original seats again after four moves? (Yes, the two children in the 2-cycle, the four children in the 4-cycle, and the children represented by the dots with loops. Do not expect your students to find all of these.)

T: Where should the child on this stool (point to a dot in the 6-cycle) be after two moves?

Let someone point to the appropriate dot.

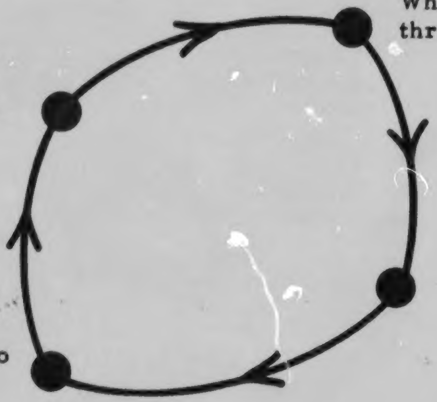
T: That is right. But this child wasn't paying attention; he changed seats twice, but he went the wrong way along the arrows. Will he end up on the right stool? (No)


Stool the child starts on
Where he's supposed to be after two moves
Where he is after two moves

K85

Now point to a dot in the 4-cycle.

T: The child on this stool was asked to change seats three times, but he too went the wrong way along the arrows. Is he going to end up where he is supposed to be? (No)



Where he is after three moves

Where the child starts

Where he's supposed to be after three moves

Finally point to a dot in the 3-cycle.

T: The child on this stool was asked to change seats three times, but he went the wrong way along the arrows. Is he going to end up on the wrong stool?

S: No.

T: Why not?

S: Because no matter which way he goes, after three moves he will end up coming back to his original seat.

TITLE: Counting Song: "Ten Green Frogs"

MATERIALS:

Teacher - Some demonstration Minicomputer checkers; a magnetic board;* (optional) a musical instrument*

Students - None

DESCRIPTION OF LESSON:

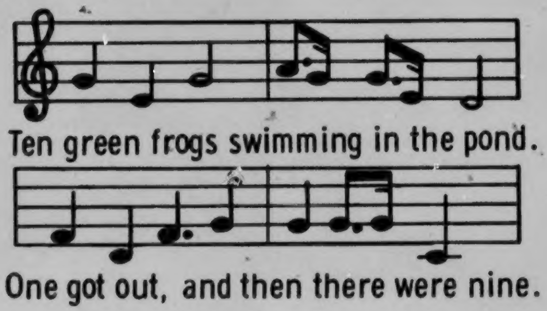
In the following song-chant the idea is for the class to fill in the blank at the end of each line by saying the appropriate number.

Place a line of ten checkers on the magnetic board, as follows:

● ● ● ● ● ● ● ● ● ●

Each time you sing "One got out," take one checker away (or let a student do this).

Here is the song:


Ten green frogs swimming in the pond.
One got out, and then there were nine.

Ten green frogs swimming in the pond.
One got out and then there were______. (9)

Nine green frogs swimming in the pond.
One got out and then there were_______.(8)

Eight green frogs swimming in the
pond. One got out and then there were ____.
(7) Etc.

K86

As soon as the children have learned the words they can accompany you in chanting them.

After having sung the song once, you could go through it again, this time letting the children act it out, or illustrate it with their fingers.

NOTE:

> Feel free to use this activity repeatedly during the remainder of the year. As a variation, you could tell the class that two frogs get out each time. In this case, sometimes you could start with ten frogs and sometimes with nine frogs.
>
> You might even try having two frogs get out followed by one getting back in, so that the numbers of frogs in the pond are successively 10, 8, 9, 7, 8, 6, 7, 5, 6, 4, and so on. This last variation will not be easy!

EARLY WARNING

> Lesson K87 calls for a full-length mirror, a few pocket mirrors, some fairly large objects, and some centimeter rods.

TITLE: Mirror Symmetry #4

IMPORTANT NOTE:

In your preparation for this lesson you would be well advised to re-read the description of Lesson K78: Mirror Symmetry #3.

Activity 1:

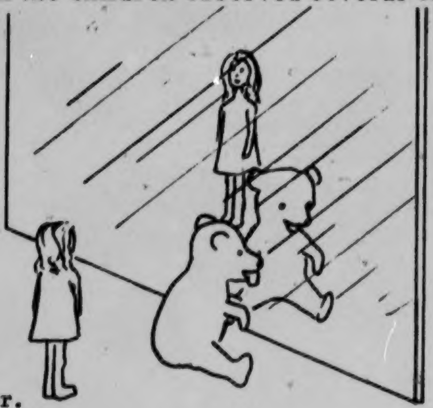
MATERIALS:

Teacher - A full-length mirror;* some fairly large objects* (e. g., large dolls, teddy bears, etc.)

Students - None

DESCRIPTION OF ACTIVITY:

Repeat Lesson K78, Activity 2, in which the children observed several objects placed in front of a mirror.



Activity 2: The Picture in the Mirror.

MATERIALS:

Teacher - A few pocket mirrors;* (optional) masking tape*

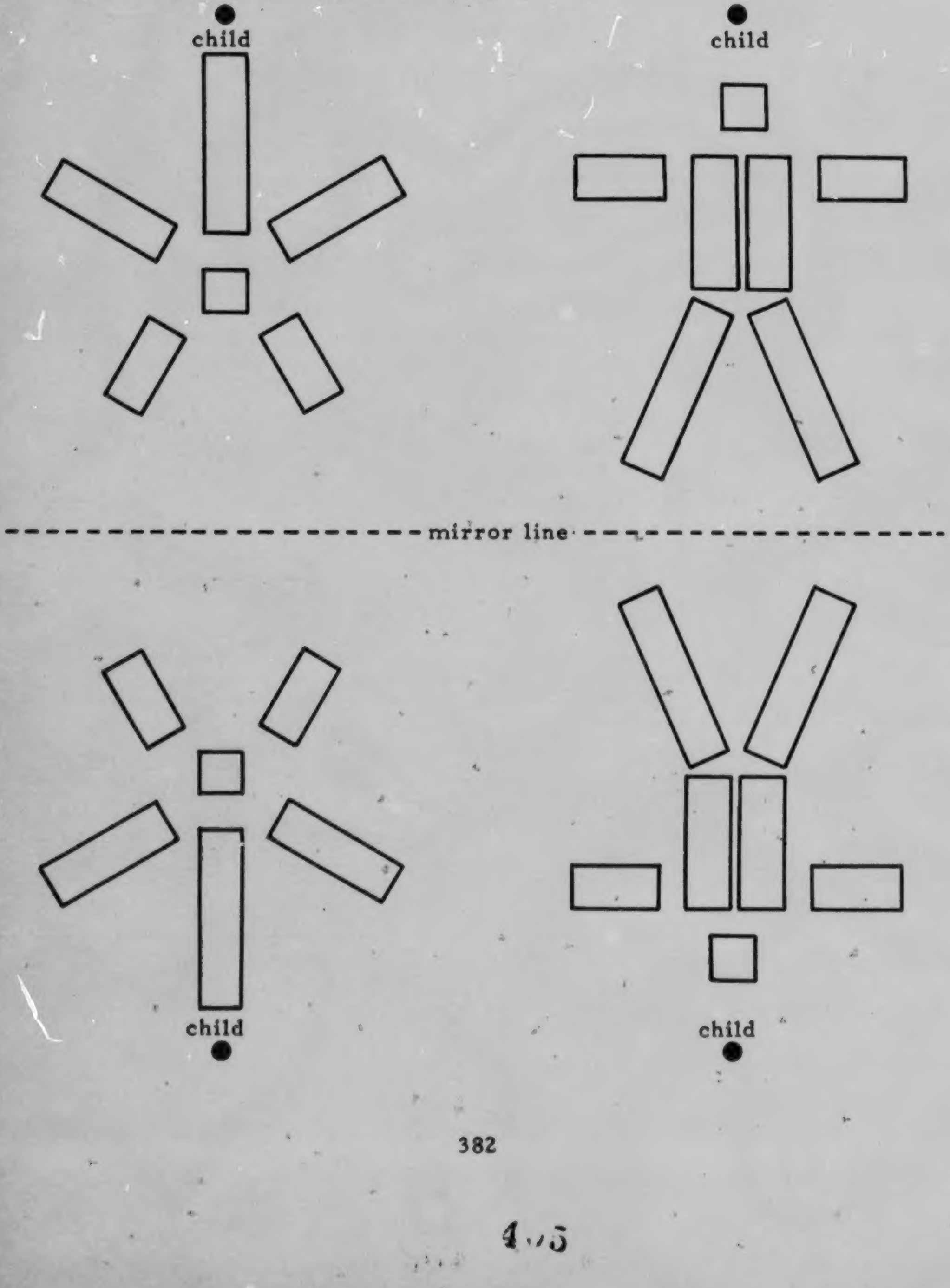
Students - Some centimeter rods* for each child

K87

DESCRIPTION OF ACTIVITY:

Repeat Lesson K78, Activity 3.

If your students are becoming adept at this activity, you might increase the challenge by giving them more rods to play with.


child
child
mirror line
child
child

Activity 3: More Pictures in the Mirror.

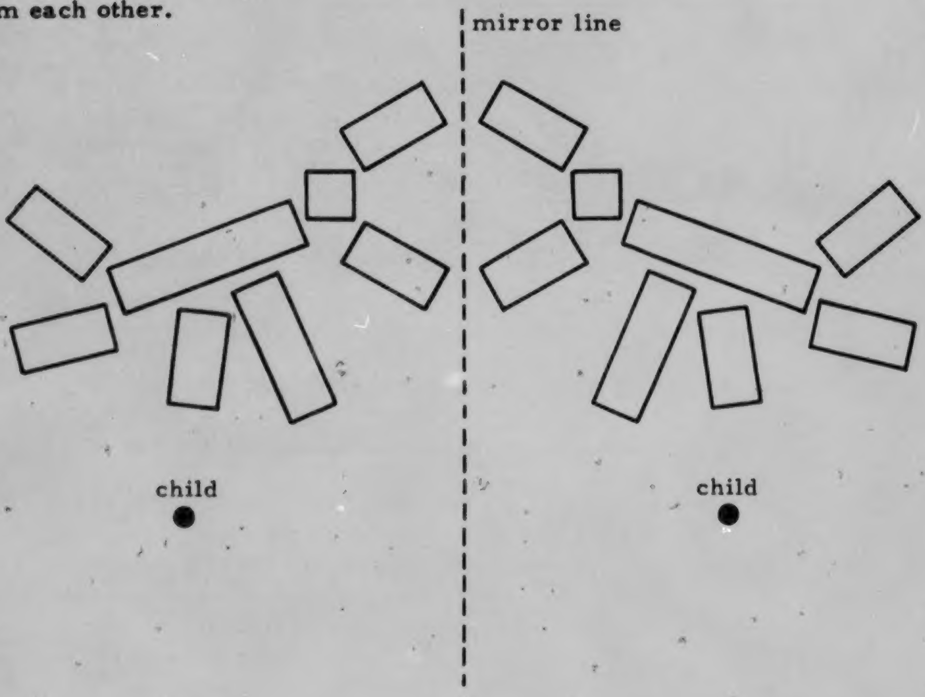
MATERIALS:

Teacher - A few pocket mirrors;* (optional) masking tape*

Students - Some centimeter rods* for each student

DESCRIPTION OF ACTIVITY:

This activity should be organized in exactly the same way as Activity 2 above, but this time the children should be seated next to each other instead of across from each other.



K88

TITLE: K - A Blocks #7 (Guess My Rule)

Repeat Lesson K25.

K89

TITLE: "What Could We Be?"

MATERIALS:

Teacher - A copy of the workbook, "What Could We Be?"

Students - A copy of the workbook, "What Could We Be?" for each student

DESCRIPTION OF LESSON:

Dots can stand for anything you like. But eight dots must always represent eight objects. This workbook gives your students a chance to imagine what the eight dots that feature in the story could be for. Sometimes a clue is given by means of a realistic picture; sometimes the children are left free to imagine whatever they like.

Try to maximize your children's involvement in the telling of the story. To that end, it might be better not to distribute the individual copies right at the beginning of the lesson. Instead, hold up your own copy* for the whole class, making sure that everyone has a clear view of both pages that are open.

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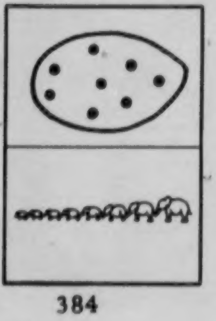
* This book has been designed to be held with the spine horizontal rather than vertical. That is,



The following dialogue will give you an idea how you could start the lesson.

Open the book to pages 1 and 2; read the text out loud to the children; let them count how many dots there are, and give them plenty of time to answer the question: "What could we be for?" A child might answer:

S: Toys.

T: How many?

S: Eight.

T: Right, we could be eight toys. What else could we be?

S: Eight children.

S: Eight butterflies.

and so on.

Now show the children pages 3 and 4, and read:

T: "We could be . . ."

S: Elephants.

T (reading): "We could be . . . eight elephants in a row."

Continue in this way throughout the workbook. On pages 8, 9, 10, 16, and 18 it would be a good idea to let the students use their fingers to show that there are eight objects altogether.

K89

It's up to you whether you try to go through the whole workbook in one lesson. You should feel free to stop the activity at some point and finish it on another day.

When you and your students have finished "reading" the story, don't rush the children into another activity. Instead, give a copy of the workbook to each child and let them look at the pictures at their own pace. You should make them feel free to share their thoughts about the workbook both with you and with their classmates.

Since workbooks are consumable, you will be ordering a new set each year. It will therefore be possible for you to let the children keep their copies of the workbook.

In addition, you should leave at least one copy of this workbook permanently available in the classroom for children who wish to glance through it in their spare time.

TITLE: Frequency Chart #2

MATERIALS:

Teacher - Colored chalk*

Students - None

DESCRIPTION OF LESSON:

Start the lesson by discussing briefly your students' pets. When you feel that the scene has been set, continue as follows:

T: It seems to me that several of you have cats, dogs and gerbils.** Let's imagine for a while that we all brought our pets to school one day. I wonder if there would be more dogs, or more cats, or more of something else. How could we find out?

Accept any sensible idea, for instance:

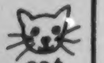
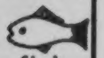
- Ask all those who have a dog to raise their hand, and then count the hands. Do the same for those who have cats, and so on.
- Line up all the people who have a dog, do the same for all those who have a cat, and so on. See which line is longer. (This is not such a good idea, since the same child might have a cat and a dog. But if someone suggests it, try it.)
- Make a chart. (If no one suggests this, do so yourself.)

** Needless to say, if your students are more the fish or snake type, modify what you say accordingly.

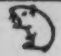
K 90

Below we provide two possibilities from which you can choose.

A. List all the kinds of pets owned by at least one of your students, and draw the following array of boxes.

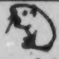
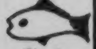
 cat											
dog											
gerbil											
 fish											
snake											
and so on											

B. Only list the two or three most popular pets (in the table below we assume they are cats, dogs and gerbils). All other pets are lumped together into the catch-all category of "Others."

cat											
dog											
 gerbil											
others											

In either of these two alternatives, each child is to mark an "x" in a box for each pet he or she owns. Since we are trying to find out which kind of animal would have the strongest representation if all your students brought theirs to class, a child who has three cats should fill in three boxes in the "cat-row," but twins who have one dog between them should not record it twice.

Let's suppose the completed chart looks like the following:

 cat	X	X	X	X	X					
 dog	X	X	X	X	X	X	X	X		
 gerbil	X	X	X	X						
 fish	X	X								
 snake	X									

Ask various questions about the chart. For example:

T: Well, if we all brought our pets to class, of which kind of animal would there be most? (Dogs)

How many more dogs would there be than cats? (Three)

Would there be fewer gerbils than cats, or fewer cats than gerbils? (The former)

How many fewer gerbils than cats? (One)

At some point you should also ask:

K90

T: If someone walked into the room, what could that person find out, just by looking at the chart?

This question is difficult.

The person could, for example, find out that no one in the class has a pet parakeet. He or she could also find out that among your students' pets there are five cats. What is not deducible from the chart is how many of your students own a cat. (It might be that all five cats belong to one of your students who is an ardent cat-lover!)

TITLE: + 1 Spiral

MATERIALS:

Teacher	-	Colored chalk*
Students	-	Paper;* pencil;* colored pens,* pencils* or crayons* (Optional) Worksheet K91

IMPORTANT NOTE:

There is just as much difference between a spiral that the children draw by themselves and a worksheet where they only have to fill in the numerals as there is between a picture that a child draws from scratch and a picture he or she merely colors in. Begin by giving the children the chance to try to draw the spiral. Only give the ready-drawn worksheets to those children who become frustrated by the difficulties they experience while attempting this task.

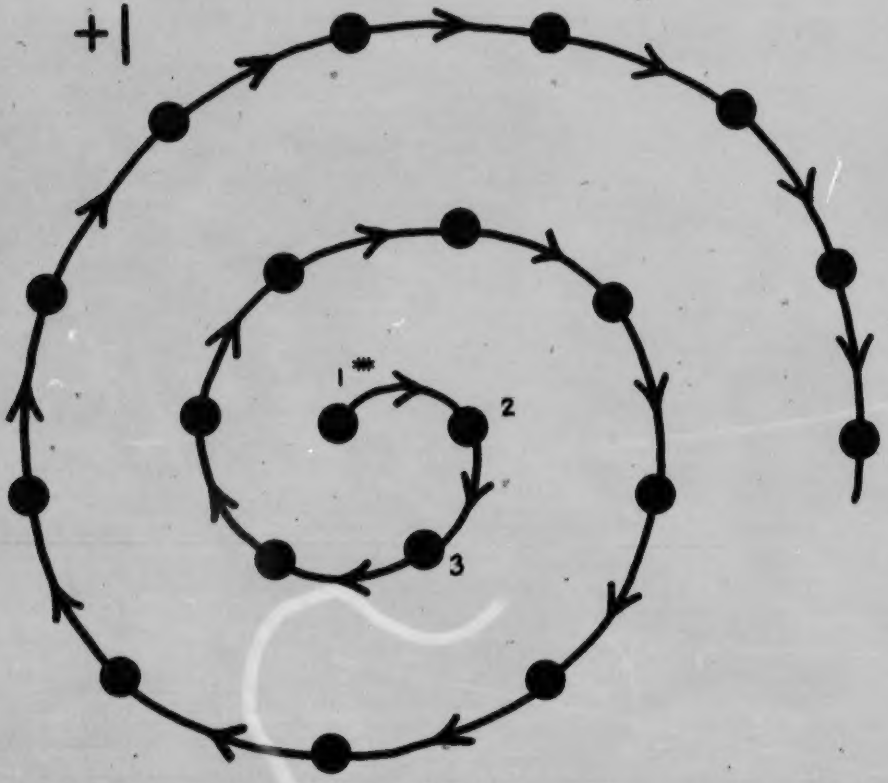
Worksheet K91 may be used for individual work at any time during the year, provided you take care to label the first dot in order to let the student know from which number to start.

DESCRIPTION OF LESSON:

Distribute paper, pencils, and colored pens (pencils or crayons). Make sure the children are seated in such a way that they can see the chalkboard.

K91

On the board, draw a large spiral as follows:



T: These dots are for numbers. They are running one behind the other. Here is the number 1. (Write "1" next to the first dot.) Then comes...

S: The number 2.

T: Right. (Write "2" next to the second dot.) Draw a spiral on your piece of paper. Start right in the middle of the page. Choose one color for the dots and numerals, and another color for the arrows. Be sure to space the dots far enough apart. (You could show your students how to leave at least two finger widths between each pair of dots.)

---

* Write these numerals on the spiral as they are called for in the lesson.

When everyone has drawn a spiral, continue as follows:

T: Now write "1" next to the first dot, and "2" next to the second dot. Who is running behind the number 2?

S: The number 3.

Continue in this way for a while. The students are to write the numerals on their papers as you write them on the board.

Then you could call on various students to help write the numerals on the board, while the others continue to write on their papers.

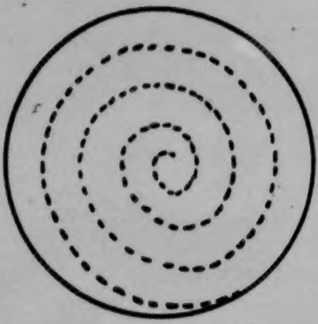
Let the faster students extend the spiral as far as they can.

We know of one case where a student kept on drawing his + 1 spiral during the individual work periods for several days. His goal was to reach 500! He never had enough time to complete his self-imposed task, however. So it was suggested that he try a + 5 spiral instead.

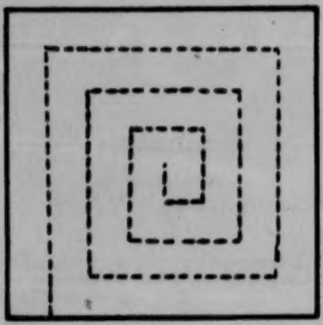
OPTIONAL CONTINUATION OF THE LESSON:

Making a Spiral Mobile.

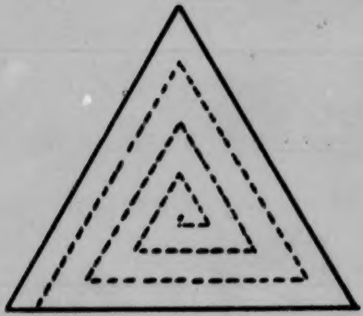
Young children seem to be fascinated by spirals. Show them how to cut a spiral out of a circle



or a square,



or an equilateral triangle



These spirals can be used to make mobiles, as follows.

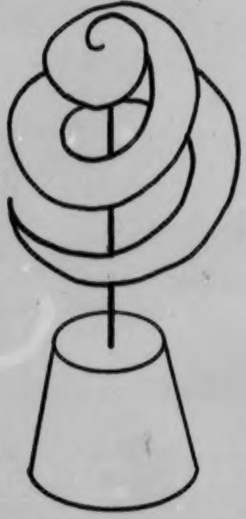
For each mobile you will need

1 cork

1 needle

1 spiral

Stick the needle into the cork, with the point sticking out. Set the center of the spiral on the point of the needle.



If you install such a mobile on top of a radiator (or any other source of warm air) the spiral will rotate continuously (the rising warm air strikes the sloping portions of the hanging spiral, thus forcing it to turn about its point of support).

K92

TITLE: Introduction to the Minicomputer #2

MATERIALS:

Teacher - Two demonstration Minicomputer boards; demonstration Minicomputer checkers; colored chalk*

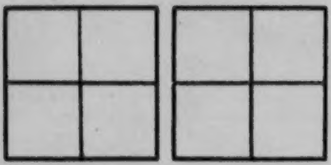
Students - None

IMPORTANT NOTE:

For some helpful hints, you should re-read Lesson K80: Introduction to the Minicomputer #1, before you teach this lesson.

DESCRIPTION OF LESSON:

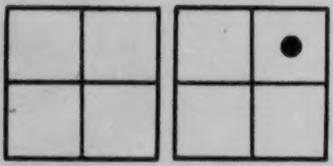
Draw your children's attention to the two Minicomputer boards mounted on your magnetic board:



and let the children explain what they remember about it.

Activity 1:

This should be a very short activity. Place a checker on the purple square of the first board:



T: What number does this show?

S: Four.

In the same way, review the Minicomputer way of writing 2, 1, 8.

Activity 2:

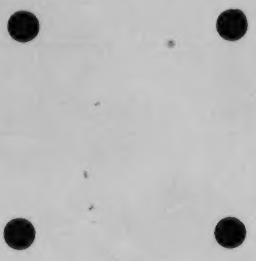
This should also be a very short activity.

T: Who could come up here and write the number 1 on the Minicomputer?

Proceed similarly for the numbers 2, 3, 4, 5, 8. (The answers to these questions are given in Lesson K80.)

Activity 3:

Draw the following arrangement of four dots on the chalkboard:

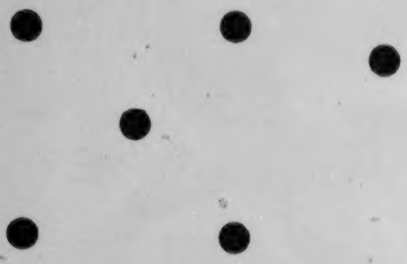


T: These are lions in a zoo. How many lions are there?

S: Four.

T: In the same zoo there are also some tigers. I'll draw blue dots for them.

Complete your drawing by adding two blue dots, as follows:



T: How many tigers are there?

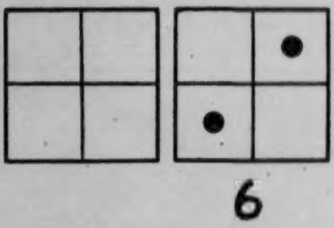
S: Two.

T: How many animals have I drawn altogether so far?

S: Six.

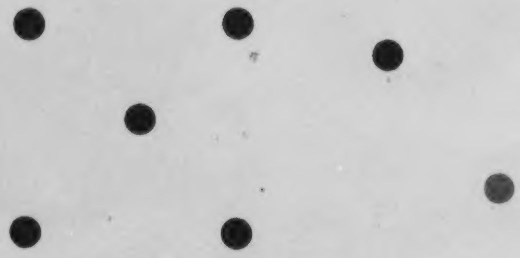
T: Let's tell this story on the Minicomputer.

Let someone place one checker for the four lions, and another checker for the two tigers. (The color of the checkers has no importance.)



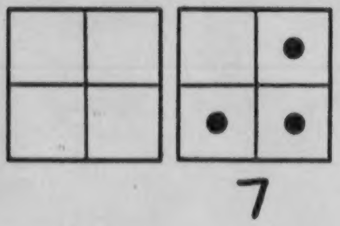
T: Just this morning, the zoo was given another animal: a leopard.

Add a yellow dot to your drawing:



T: How many animals are there now? (Seven)

Could someone show 7 on the Minicomputer?



T: Right: 4 + 2 + 1 = 7.

Could someone show 7 in another way?

See Lesson K80 for suggestions on how to check answers.

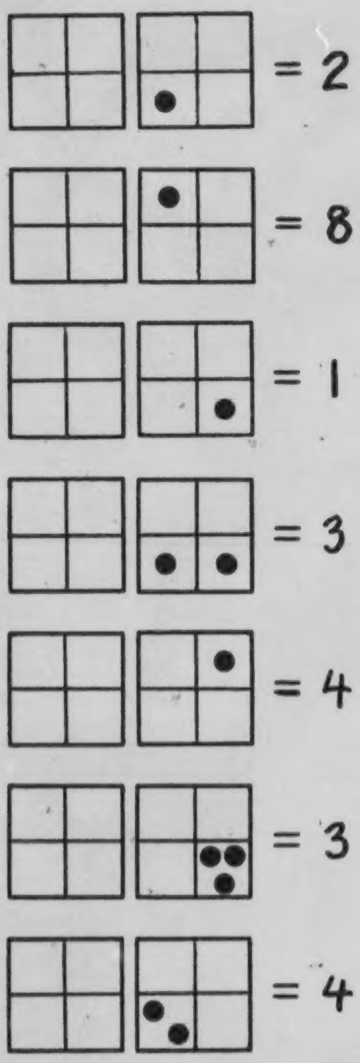
Activity 4:

T: I am going to show a number on the Minicomputer. Your job is to tell me which number it is.

The students can either say the numbers out loud, mouth the answers (see p. 34), or show the numbers on their fingers.

K92

Here are some numbers you might use:



NOTE:

Two copies of the storybook TWO BY TWO, which deals with the introduction of the Minicomputer, have been included

in the Teacher's Materials. See Section Four of this guide (Small Group Activities) for suggestions on how to use them.

EARLY WARNING:

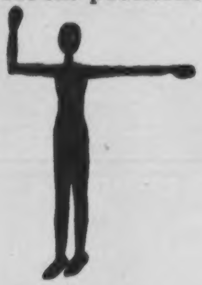
Lesson K93 calls for a very special "robot" doll.

K93

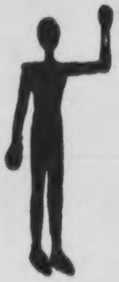
TITLE: Robot Walk #4

IMPORTANT NOTE:

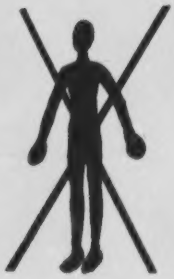
In order for the children to be able to distinguish the robot's right from the robot's left at a glance, the small doll you use during this lesson should be capable of having its hands in different positions.



Acceptable

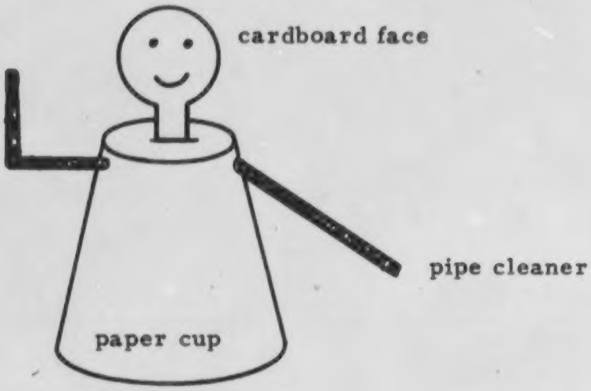


Acceptable



Not Acceptable

A doll with movable arms would do beautifully. If you cannot secure one, however, you can easily make such a doll out of a paper cup, a suitably cut piece of cardboard on which you have drawn a face, and a pipe cleaner, which you stick through the paper cup to act as the arms. See the picture below.



Activity 1:

MATERIALS:

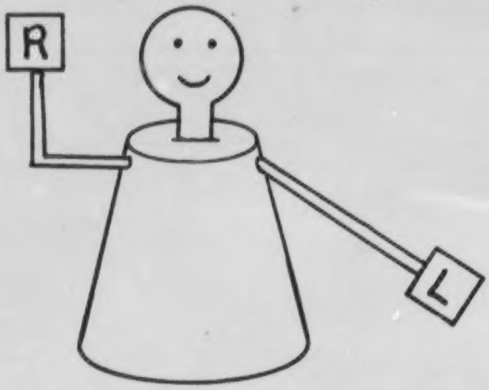
Teacher - A small doll* with the capability of having its hands in different positions (see the note above); some scotch tape*

Students - None

DESCRIPTION OF ACTIVITY:

Set up your class in the same way as you did in Lesson K19 and remind the children of the rules which were explained on the occasion of that lesson.

Produce the robot (that is, the small doll) and point out to the children that its right hand is raised.** (At this point, it might be helpful to tape a small piece of paper marked "R" to the right hand of the robot, and one marked "L" to its left hand.)



Place the robot on a flat surface, choose a robot operator, and give him or her the following sequence of directions:

** Or its left hand, if that's the case with your particular robot.

T: Turn the robot to its right.*

Turn the robot to its right again.

Turn the robot to its right once more.

Turn the robot to its right once more.

What do you notice? (The robot is back in the position from which it started.)

Repeat this activity with another operator but this time ask him or her to turn the robot to its left four times in a row.

Choose a third operator and give these instructions:

T: Turn the robot to its right.

Now turn the robot to its left.

What do you notice? (Once again, the robot is back in the position from which it started.)

Activity 2:

MATERIALS:

Teacher - The doll* from Activity 1; a copy of the Robot Walk Grid

Students - None

DESCRIPTION OF ACTIVITY:

Display the Robot Walk Grid and attach it to some horizontal surface. Place

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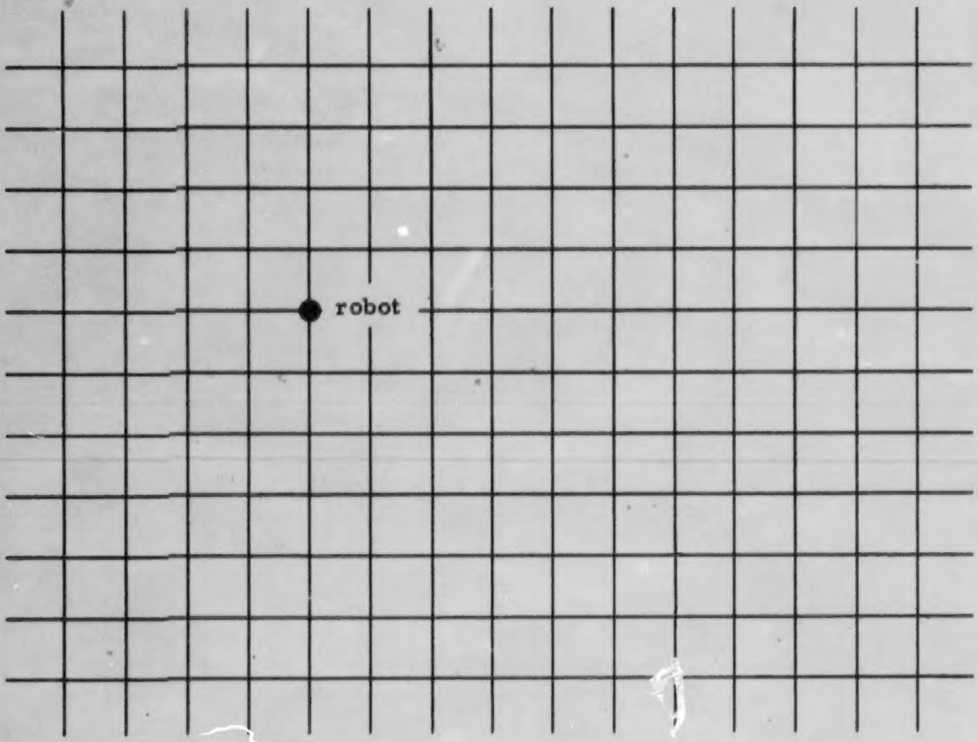
* If there is any confusion about how far round the robot should be turned, get the idea across that your instruction means "Give the robot a quarter-turn clockwise."

427

the robot on an intersection.



Choose a child to operate the robot. You give directions one at a time to the robot, and the operator makes the robot carry them out. THIS TIME, YOU SHOULD INCLUDE DIRECTIONS SUCH AS "TURN TO YOUR RIGHT" AND "TURN TO YOUR LEFT."

For instance:

Forward two steps
Turn to your right
Back one step
Turn to your left

and so on.

Activity 3:

MATERIALS:

Teacher - The doll* from Activity 1; a copy of the Robot Walk Grid

Students - None

DESCRIPTION OF ACTIVITY:

This activity repeats Activity 2, except that this time one child operates the robot while another one gives the directions, one at a time. (Encourage the child who is giving the directions to use expressions such as "Turn to your right" and "Turn to your left.")

As stated in Lesson K19, directions which, if obeyed, would send the robot off the portion of the grid which you have displayed are illegal. As suggested in that lesson, when a child gives such a direction:

- the whole class should be encouraged to protest (by raising both arms, for example)
- the robot ignores it, and
- the child who gave the direction has to pass on the responsibility for giving directions to someone else.

Activity 4[**]:

MATERIALS:

Teacher -	(Optional) Some means* of producing background music, either your playing a musical instrument,* a tape recorder,* or a record player*
Students -	A distinguishing mark* on their right hands (a dab of paint,* or a colored ribbon* tied around their right wrists, etc.)

DESCRIPTION OF ACTIVITY:

In this activity, the idea is for your children to move freely about the classroom or the playground, and to freeze at certain moments which you indicate either by saying, "Freeze!" or by stopping some background music. In what follows we assume you are using the background music method.

T: When the music stops, you must freeze exactly where you are without moving a muscle until I tell you to.

Stop the music. Everyone should freeze.

T: Look around you.

Raise your right hand (the one with the distinguishing mark on it).

Turn to your right. Turn to your right again. Look around you again.

Start the music up again. The children should start moving around again.

[**] You are not obliged to engage in this activity during the mathematics lesson. It could take place at any time during the day.

K93

Stop the music.

T: Look around you.

Raise your left hand.

Turn to your left.

Now turn to your right.

Look around you again.

Continue this activity at will.

TITLE: The Friendly Numbers

MATERIALS:

Teacher - Colored chalk*

Students - (Optional) Worksheet K94

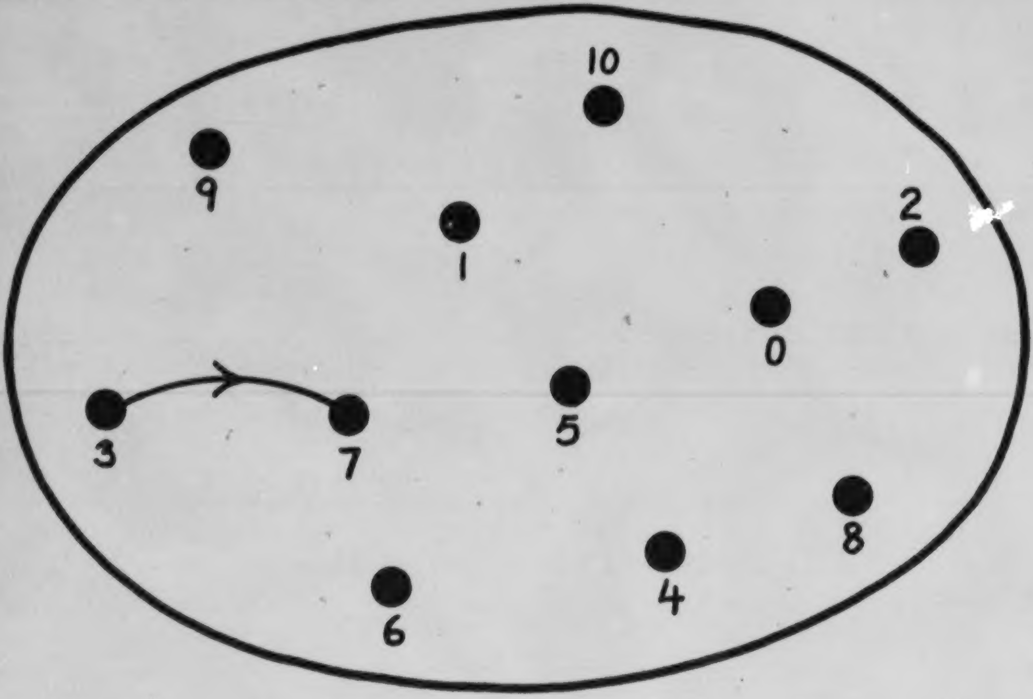
IMPORTANT NOTE:

There are several ways of organizing this lesson:

1. You could complete the arrow picture with the whole group, and then let those children who are interested copy the picture onto a copy of the worksheet later on.
2. You could give everyone a copy of the worksheet at the beginning of the lesson, then complete the arrow picture as a group while those children who so desire copy what is happening on the board onto the worksheet.
3. You could start the arrow picture with the class all together, and, after a while, let your better students work on their own on the worksheet, while you continue working at the chalkboard with the slower ones.

DESCRIPTION OF LESSON:

Draw the following diagram on the chalkboard:



The final "look" of the completed arrow picture will benefit from your thinking in advance which arrows will be drawn. This will help you as you decide how to label the dots.

As you draw the first arrow say:

T: 3 is the friend of 7 because 3 + 7 = 10.[**]

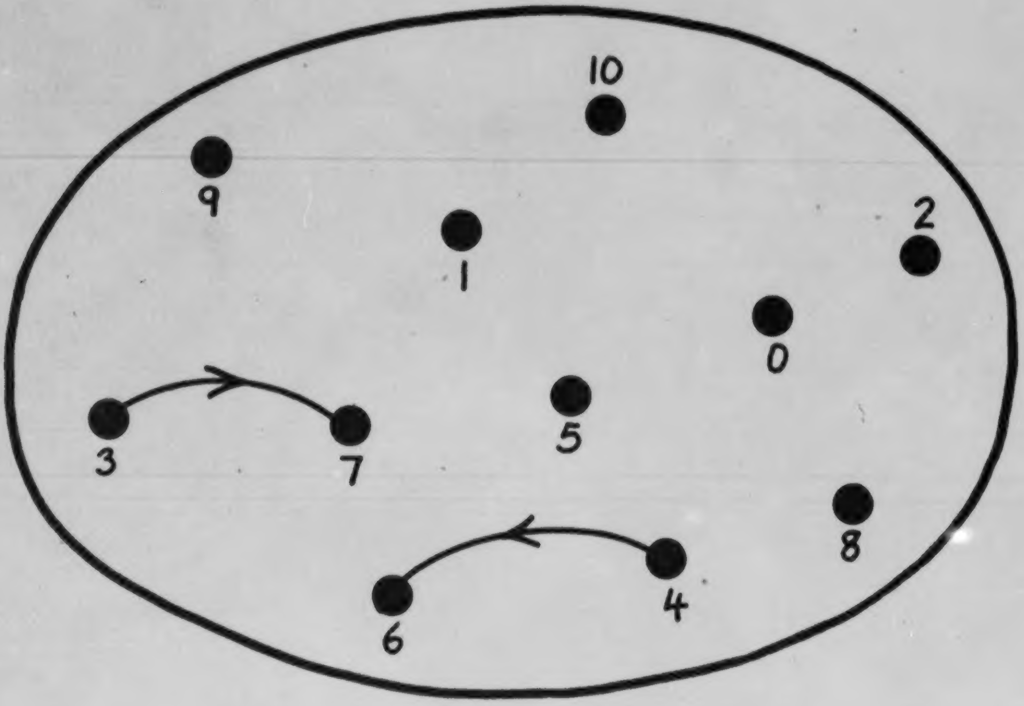
Who is the friend of 6?

[**] Don't forget to say the last part of this sentence. Without it, the children have no way of knowing why 3 and 7 happen to be friends today.

One way to involve everyone in answering this question is to let the children either mouth the answer[*] or else show it on their fingers.

S: 4.

Draw the second arrow from 4 to 6:



Continue either by letting the children name two numbers who are friends or by asking questions similar to those above.

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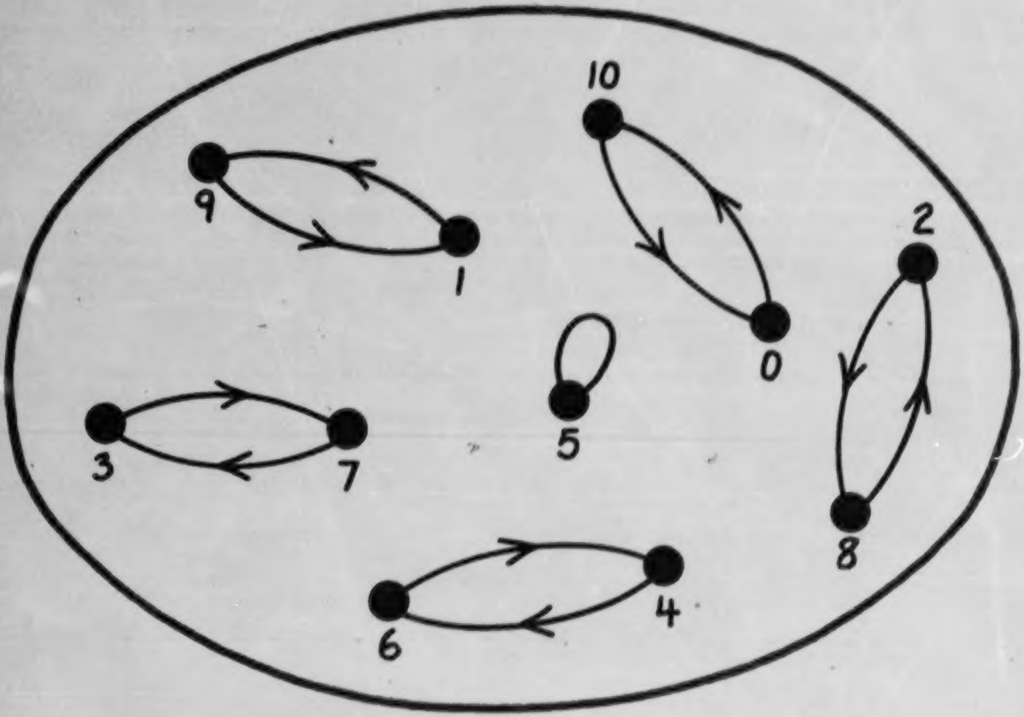
[*] See page 34.

The complete arrow picture should look as follows:



IMPORTANT NOTE:

You may find that none of the return arrows are being suggested. The discovery of these, however, is a very important step in this lesson. Be patient. If you reach the stage where all the arrows have been found except the return arrows, say:

T: We know that 3 is the friend of 7. Who is the friend of 3?

S: 7.

T: Could you show that on our picture?

If in addition your children have difficulty discovering the loop at 5, ask questions that bring out the fact that 5 is its own friend since 5 + 5 = 10.

T: That means we need arrows going from the dot for 5 (start drawing an arrow leaving the dot for 5) and coming right back (curve the arrow you are drawing back towards the dot for 5 and complete the loop).

EARLY WARNING:

Lesson K95 calls for a paper cup containing about 15 checkers (or bottle caps, etc.) for each student.

K95

TITLE: The Jumpy Frogs #2

MATERIALS:

Teacher - Colored chalk*

Students - A piece of paper* and a paper cup* containing about 15 checkers for each student

IMPORTANT NOTE:

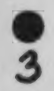
The only difference between this lesson and Lesson K77 is that here you are to record the story by means of an arrow picture. As stated in Lesson K77, instead of checkers you could use buttons, soda bottle caps, oyster crackers, Fruit-Loops, etc.

DESCRIPTION OF LESSON:

Give each child a piece of paper and a paper cup containing about 15 checkers.

T: Let's pretend you are walking through a forest, and you have just come into a clearing. In the middle of the clearing there is a pond (point to one of the children's piece of paper). All around the pond, you can see lots and lots of frogs. These are the frogs (point to the checkers in one of the children's paper cup). Suddenly, three of the frogs jump into the pond.

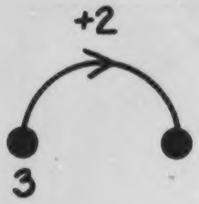
Draw the following on the board:



Ask each child to take three checkers out of his or her paper cup and place them on his or her piece of paper. (As the lesson proceeds, each of your statements should be mirrored in this way by the children's placing checkers on their pieces of paper or removing them and returning them to their paper cup.)

T: Two more frogs hop into the pond.

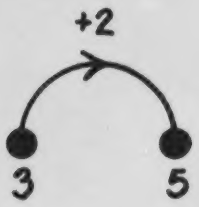
As you speak, continue your drawing in a casual way:



T: How many frogs are in the pond now?

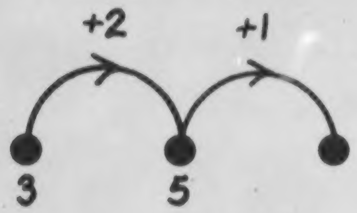
S: Five.

Label the right hand dot:



T: One more frog jumps into the pond.

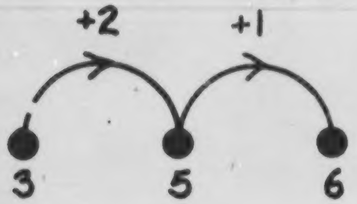
As you speak, draw:



T: How many frogs are in the pond now?

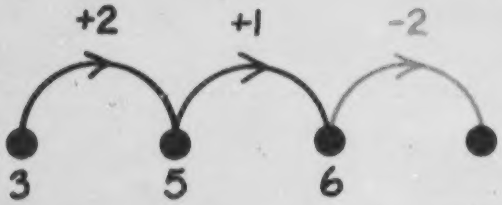
S: Six.

Label the appropriate dot:



T: Two of them decide to leave.

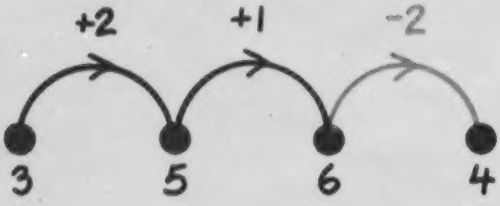
Continue your drawing:



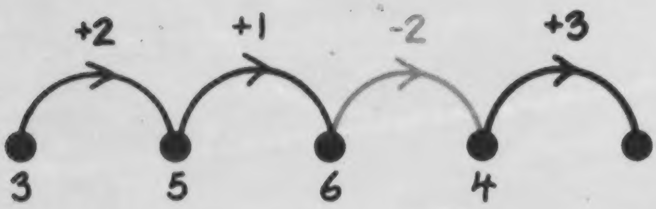
T: How many frogs are left in the pond?

S: Four.

Label the appropriate dot:



Continue your drawing:



T: What has happened now?

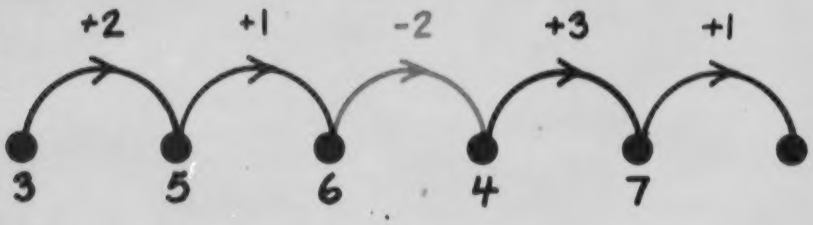
S: Three more frogs.

T: So, in the pond there are ...

S: ... seven frogs.

K95

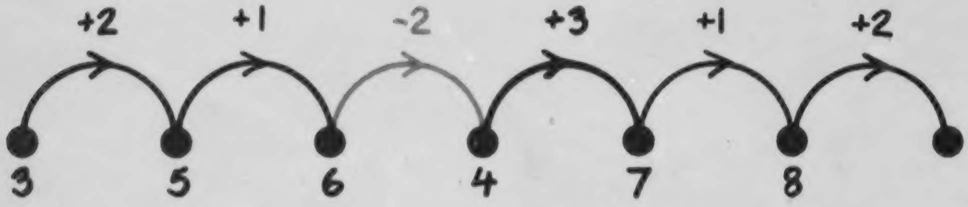
Continue the drawing once again:


+2
+1
-2
+3
+1
3
5
6
4
7

S: One more frog.

S: That makes eight.

One last arrow:

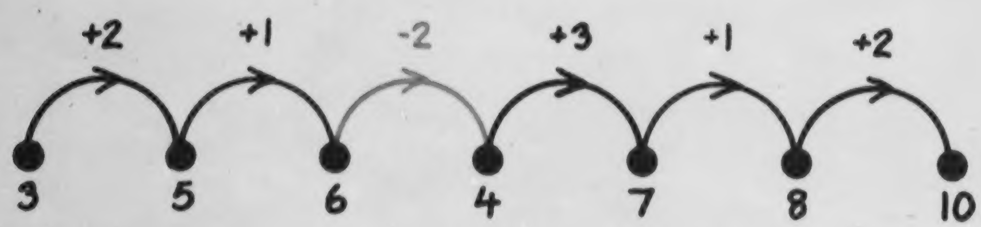

+2
+1
-2
+3
+1
+2
3
5
6
4
7
8

S: Two more frogs.

T: How many frogs altogether?

S: Ten.

Complete your drawing by labeling the last dot:


+2
+1
-2
+3
+1
+2
3
5
6
4
7
8
10

EARLY WARNING:

Lesson K96 calls for some string or yarn in three or four different colors.

K96

TITLE: Measurement #3

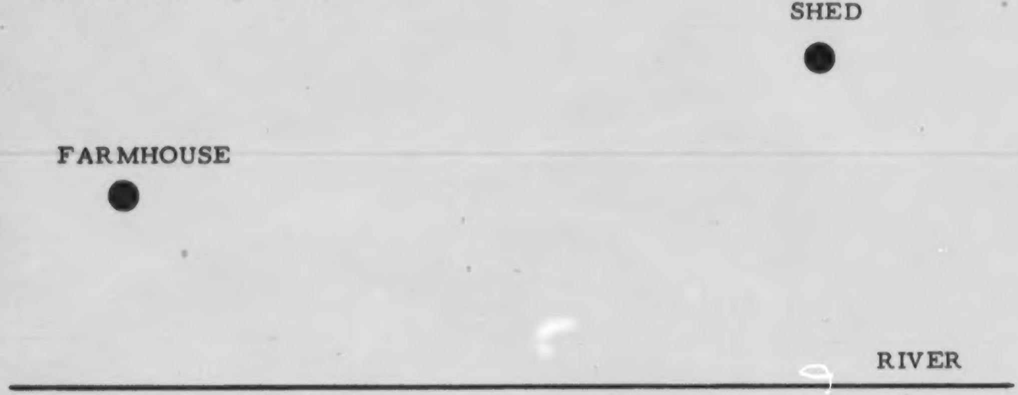
MATERIALS:

Teacher - Colored chalk;* string* or yarn* (if possible, in three or four different colors)

Students - None

DESCRIPTION OF LESSON:

Draw the following on the board:



As you are drawing, start telling the following story:

T: Johnny lives on a farm. (Point to the dot for the farmhouse.) His father is building a shed way over on the other side of the field. Today Johnny is helping his dad by bringing some wood from the farmhouse over to the place where the shed is being built. He is moving the wood using a push-cart, and it is quite a job!

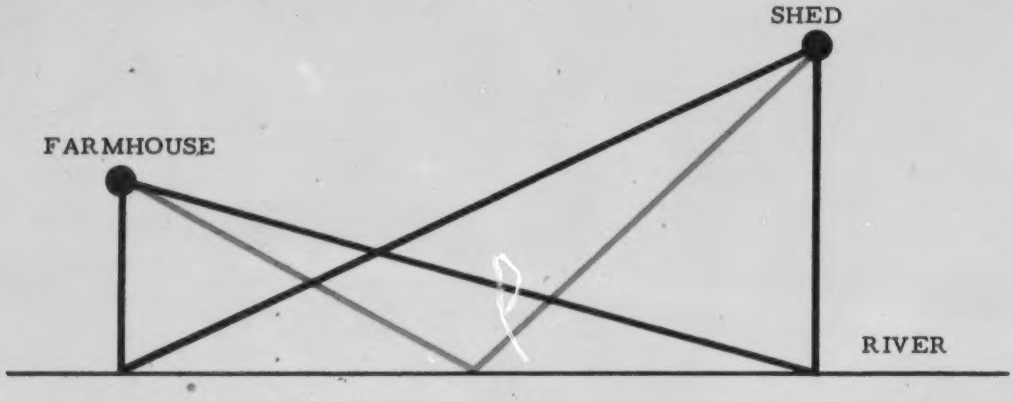
What is the shortest way for him to push the push-cart full of wood from the farmhouse to the shed?

Probably, most students will agree on the straight line segment joining the farmhouse and the shed.

T: That's right. That's the shortest way. But it's terribly hot today. So Johnny decides to make a detour and go by the river to have a swim. Could someone think of a very short way for him to push his cartload of wood from the farmhouse down to the river and then on to the shed?

Let several children come to the board and trace what they think would be a very short way. Record each suggestion by drawing a path of a different color.

After a while your board might look something like this:



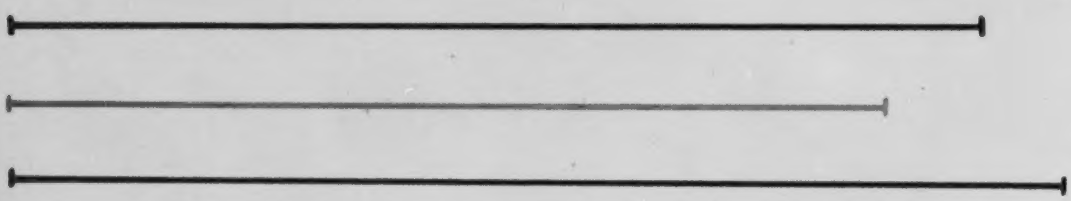
T: Which of these three paths do you think is the shortest?

Probably there will not be general agreement on the answer to this question.

T: How could we find out for sure which of these paths is the shortest?

The students will probably suggest that you measure. Produce your string (or yarn), and ask some children to help you measure each path.

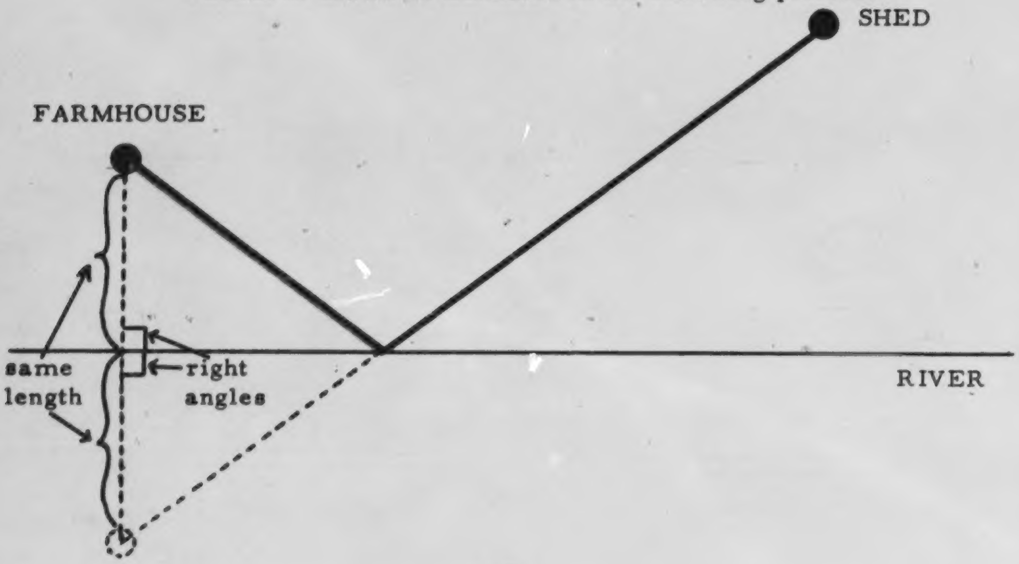
Tape the resulting lengths of string (or yarn) on the board and conclude that the yellow path is the shortest of the three.



If someone thinks he or she knows a path that is shorter than the yellow one, let him or her draw that path, measure it, and compare its length to the length of the yellow path.

NOTE (FOR YOUR INFORMATION ONLY):

> There are an infinite number of possible paths from the farmhouse to the shed via the river. The shortest one is the one which is drawn as indicated in the following picture:



There is no way for your students to find this particular path (except by sheer luck!). For this reason you should be careful in the lesson to ask for "a very short way" and not "the shortest way."

EARLY WARNING:

Lesson K97 calls for 27 small paper rectangles or 27 large magnetic checkers. You will also need numeral cards from 11 to 39 inclusive (with the exception of 20 and 30).

K97

TITLE: Movie Theater #2

MATERIALS:

Teacher - 0-99 Numeral Chart; either 27 small rectangles of paper* and some scotch tape* or 27 large magnetic checkers* and a magnetic board;* numeral cards* (or bingo or lotto checkers*) from 11 to 39 inclusive (with the exception of 20 and 30) - the ones you used in Lesson K83 would be perfect!

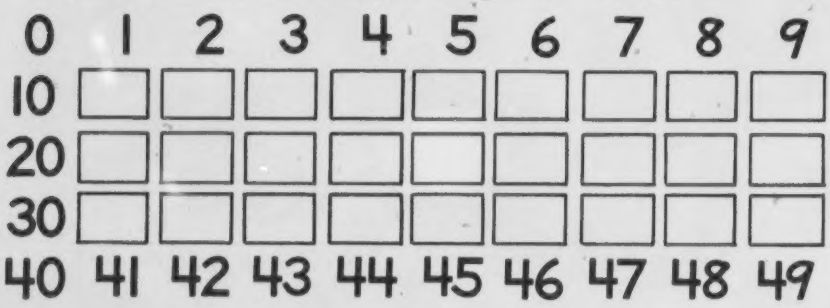
Students - None

IMPORTANT NOTE:

The purpose of the paper rectangles or large magnetic checkers is to provide individual covers for some of the numerals in the 0-99 Numeral Chart.

If you are not using a magnetic board and large checkers:

- fold the 0-99 Numeral Chart in half so that just the numerals in the range 0-49 are visible
- cover each of the numerals individually with a small paper rectangle (approximate dimensions: 5cm x 4cm) with the exception of those numerals in the first and last rows and those in the first column (see the picture below.)



If you are using a magnetic board and large checkers:

- fold the 0-99 Numeral Chart in half so that just the numerals in the range 0-49 are visible, and tape the folded chart onto the magnetic board (alternatively, you could copy the top half of the 0-99 Numeral Chart onto your magnetic board)
- cover each of the numerals (except those in the first and last rows, and the first column) individually with a large checker.

The Demonstration Numeral Cards provided by CSMP only go up to 30, so you should find some other kind of numeral card. For this purpose, you could use bingo or lotto checkers. (The simplest thing would be for you to re-use whatever you used in Lesson K83.)

DESCRIPTION OF LESSON:

Explain to the children that the 0-99 Numeral Chart is the plan of a movie theater in which each seat is numbered. The children are to take turns to choose a card at random from your deck of numeral cards, read the number written thereon, and then take his or her seat (that is, the place on the chart with the same number) by removing the appropriate paper rectangle or large checker.

This activity might sound easy, but in fact you will probably find that some of your students need several attempts before they are able to locate their seat.

Once everyone has "taken their seats" in the movie theater, ask the students if they can say which numerals are still covered up (these are the empty seats).

K98

TITLE: Interpretation of an Arrow Picture #2

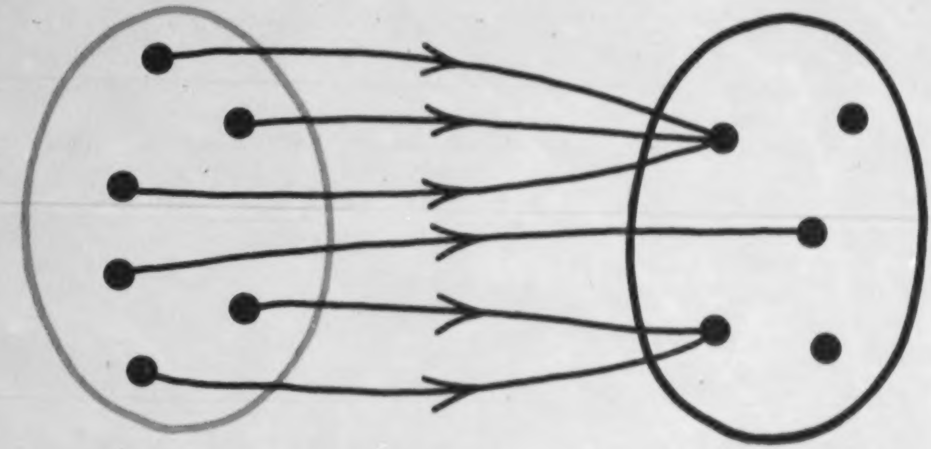
MATERIALS:

Teacher - Colored chalk*

Students - None

DESCRIPTION OF LESSON:

Draw the following arrow picture on the board:



T: Today you're once again going to have a chance to make up a story. Think carefully first, though, because your story has to go with this arrow picture.

You might have a certain amount of "editing" to do as the children's stories are being told. For each story, the following things need to be clarified:

In each string, what are the dots for?

What are the arrows for?**

** Within a story, all the arrows should have the same meaning.

Here is how you could "draw out" a child's story.

S: I have a story about people who go to the lake and throw pieces of bread to the swans.

T: That sounds like a fine story. Where are the swans?

S: In the second string (that is, the one on the right).

Let the child touch each dot in this string with his or her finger.

T: What are the dots in the first string for?

S: Pieces of bread.

Again, let the child touch these dots with his or her finger.

T: What are the arrows telling us?

S: That the swans eat the bread.

T: That's a good idea, but look which way the arrows are going.

Trace along one of the arrows from left to right as you say:

T: This piece of bread ...

S: ... is eaten by this swan.
And this one is eaten by this swan.

Now ask the class a couple of questions about this story. For instance:

T: Which swan eats the most bread?

What about this swan (one of the two dots with no arrows pointing to them)?

How many swans didn't eat any bread? (Two)

How many swans received some bread? (Three)

Here are some other examples of stories that children have invented:

a) Dots on the left: Birds

Dots on the right: Nests

Arrows: " ... lives in ... "

b) Dots on the left: Children

Dots on the right: Places (such as the zoo, the playground and so on)

Arrows: " ... goes to ... "

c) Dots on the left: Cats

Dots on the right: Mice

Arrows: " ... is chasing ... "***

d) Dots on the left: Pilots

Dots on the right: Airplanes

Arrows: " ... flies ... "

Sometimes it happens that the children keep on suggesting variations of the first story. For example:

1) Dots on the left: Pieces of bread

*** This story would probably result in a fight between the cats, but that's OK!

Dots on the right: Birds

Arrows: " ... is eaten by ... "

2) Dots on the left: Pieces of bread

Dots on the right: Gerbils

Arrows: " ... is eaten by ... "

In such a case, you could ask if someone can make up a different story, about something other than pieces of bread being eaten by someone.

NOTES:

1. Occasionally, a child suggests a story which, despite all your efforts, you cannot fit with the arrow picture. In such a case, say something along the following lines:

   T: That's a nice story, but I don't think it fits my arrow picture.

   You might want to draw an arrow picture that fits the child's story (if that's possible!).

2. Sometimes a child suggests a story that isn't at all compatible with the arrow picture. For example:

   Dots on the left: Mothers

   Dots on the right: Children

   Arrows: "You are my child."

   Let the class discuss the story. Try to point out that one of the children would have three mothers, which is not possible. In this particular example, however, you can easily make this story fit the arrow picture by putting the mothers in the right string and the children in the left. The arrows could then say: "You are my mother."

TITLE: Introduction to the Minicomputer #3

MATERIALS:

Teacher - Two demonstration Minicomputer boards; demonstration Minicomputer checkers; colored chalk;* demonstration Numeral Cards (from 1 to 10)

Students - None

IMPORTANT NOTE:

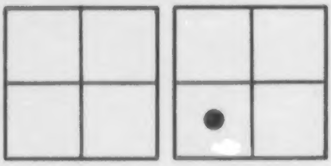
Before teaching this lesson, you will find it useful to re-read Lesson K80: Introduction to the Minicomputer #1.

DESCRIPTION OF LESSON:

Draw your children's attention to the two Minicomputer boards mounted on your magnetic board, and let them explain what they remember about the Minicomputer.

Activity 1:

This should be a very short activity. Place a checker on the red square of the first board:



T: What number is this?

S: Two.

In the same way, review the Minicomputer way of writing 4, 1, 8.

Activity 2:

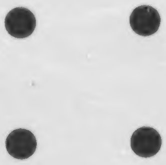
This should also be a very short activity.

T: Who could come up here and write the number 1 on the Minicomputer?

Proceed similarly for the numbers 2, 3, 4, 5, 6, 7, 8. (The answers to these questions are given in Lesson K80.)

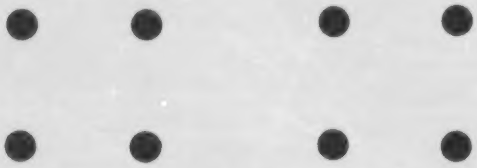
Activity 3:

Draw the following arrangement of four dots on the chalkboard:



T: These red dots are for cars in a parking lot. How many of them are there? (Four) Now, along come some trucks.

Add four dots to your drawing as follows:



T: How many trucks are there?

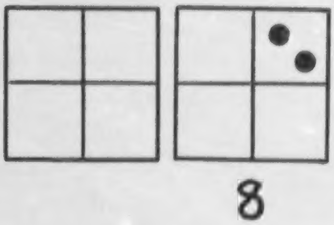
S: Four.

T: How many vehicles are there altogether in my parking lot?

S: Eight.

T: Let's tell this story on the Minicomputer.

Let someone place one checker for the four cars, and another checker for the four trucks. (The color of the checkers has no importance.)

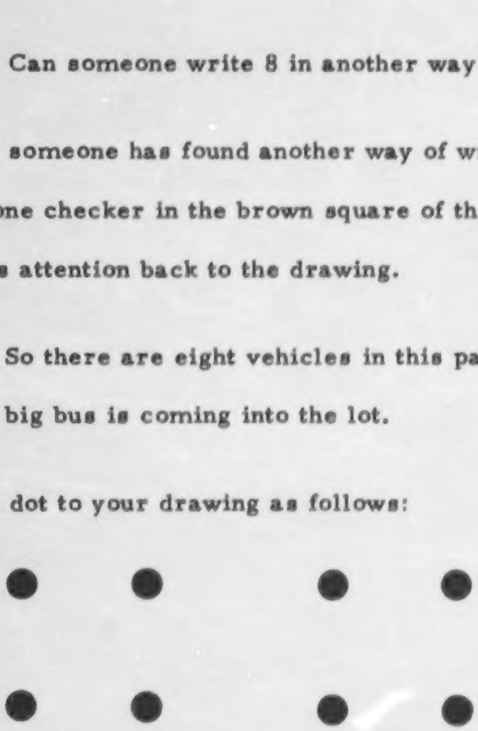


T: Can someone write 8 in another way?

When someone has found another way of writing 8 (perhaps the standard way with one checker in the brown square of the first board), redirect the children's attention back to the drawing.

T: So there are eight vehicles in this parking lot. Just at the moment, a big bus is coming into the lot.

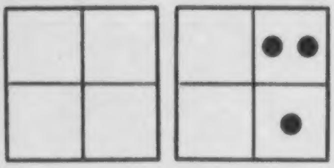
Add a dot to your drawing as follows:



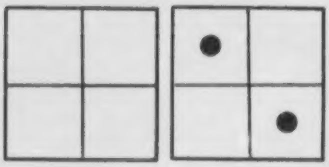
T: How many vehicles are in the lot now? (Nine)

Could someone write 9 on the Minicomputer?

The answers you are most likely to get are



OR



T: That's right: 4 + 4 + 1 = 9 (or 8 + 1 = 9).

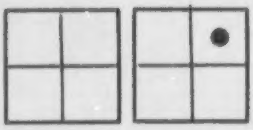
Can someone write 9 on the Minicomputer in another way?

Let the children check whatever answers are proposed by using their fingers.

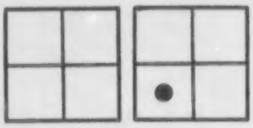
Activity 4: Don't Make a Sound.

Put a number on the Minicomputer. Then display the numeral cards one by one. The students should not make a sound until the matching card is shown. But when the matching card is shown they should call out, "That's it!"

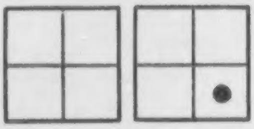
Here are some examples of the configurations you might use



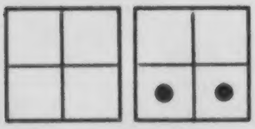
= 4

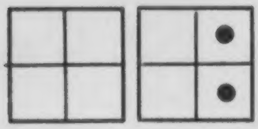


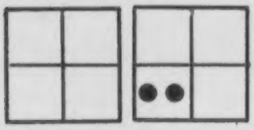
= 2

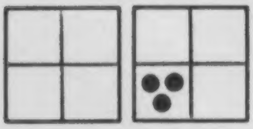


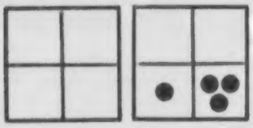
= 1

 = 3

 = 5

 = 4

 = 6

 = 5

K100

TITLE: + 2 Spiral

MATERIALS:

Teacher Colored chalk*

Students Paper;* pencil;* colored pens* (pencils* or crayons*)

(Optional) Worksheet K100

IMPORTANT NOTE:

As was mentioned at the beginning of Lesson K91, there is just as much difference between a spiral that the children draw by themselves and a worksheet where they only have to fill in the numerals as there is between a picture that a child draws from scratch and a picture he or she merely colors in. Begin by giving the children a chance to try to draw the spiral. Only give the ready-drawn worksheet to those children who become frustrated by the difficulties they experience while attempting this task.

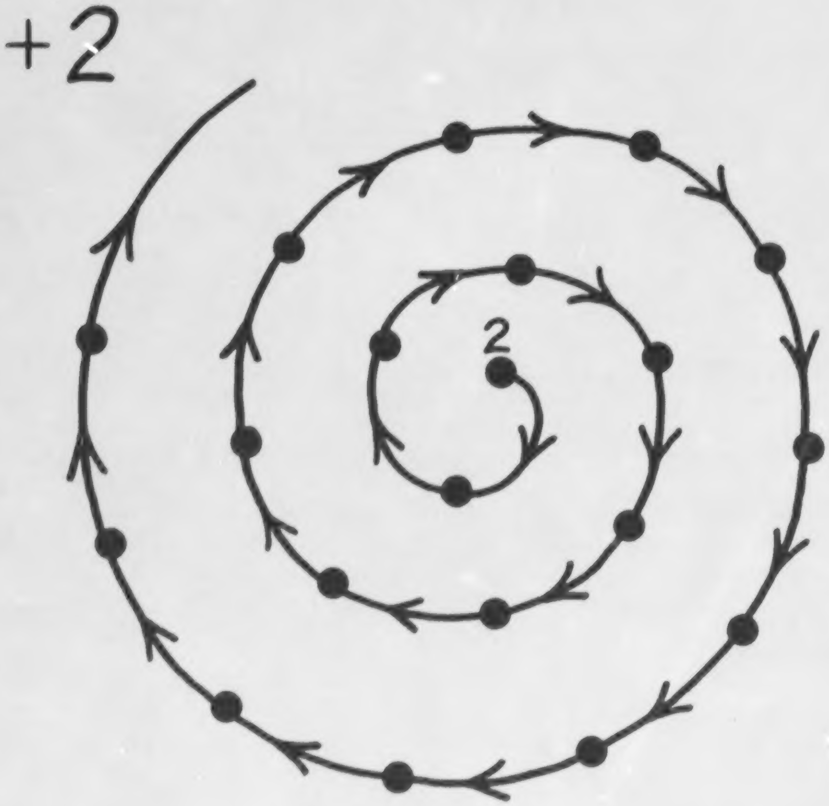
Worksheet K100 may be used for individual work provided you label the first dot before giving the worksheet to a student.

DESCRIPTION OF LESSON:

Distribute paper, pencil, and colored pens (pencils or crayons). Make sure the children are seated in such a way that they can see the chalkboard.

Ask the children to hold up two fingers, then two more, and two more, . . . until each child has all ten fingers showing.

Draw a large spiral on the board, as follows:



As you label the first dots, ask the children to hold up their fingers again, adding two at a time.

T (tracing along the first arrow): Two, and two more is . . .

S: . . . four.

T: Right. (Write "4" next to the second dot.) Draw a spiral on your piece of paper. Start right in the middle of the page. Choose one color for the dots and numerals, and another color for the arrows. Be sure to space the dots far enough apart. (You could show your students how to leave at least two finger widths between each pair of dots.)

When everyone has drawn a spiral, continue as follows:

T: Now write "2" next to the first dot, and "4" next to the second dot. (Trace along the second arrow.) Four and two more is ...

S: ... six.

Continue in this way for a while. The students are to write the numerals on their papers as you write them on the board.

Then you could call on various students to help write the numerals on the board, while the others continue to write on their papers.

Let the faster students extend the spiral as far as they can.

NOTE:

> Some students might want very much to draw another spiral. In such a case, you could ask the "slower" children to draw a "+ 1 spiral" (as in Lesson K91), and the "faster" children could be asked to draw a "+ 2 spiral" starting at 1 (instead of 2).

EARLY WARNING:

> Lesson K101 calls for a 25cm diameter ball, a half-pint milk or cream carton, a coffee mug and a 10-ounce returnable Pepsi-Cola bottle. Be sure to have these items available before the lesson begins.

TITLE: What Do You See?

MATERIALS:

Teacher	A 25cm diameter ball;* a half-pint milk or cream carton;* a coffee mug;* and a 10-ounce returnable Pepsi-Cola bottle* (see Note #1 below)
Students	Worksheets K101-I, II, III, IV, V (see Note #2 below)

IMPORTANT NOTES:

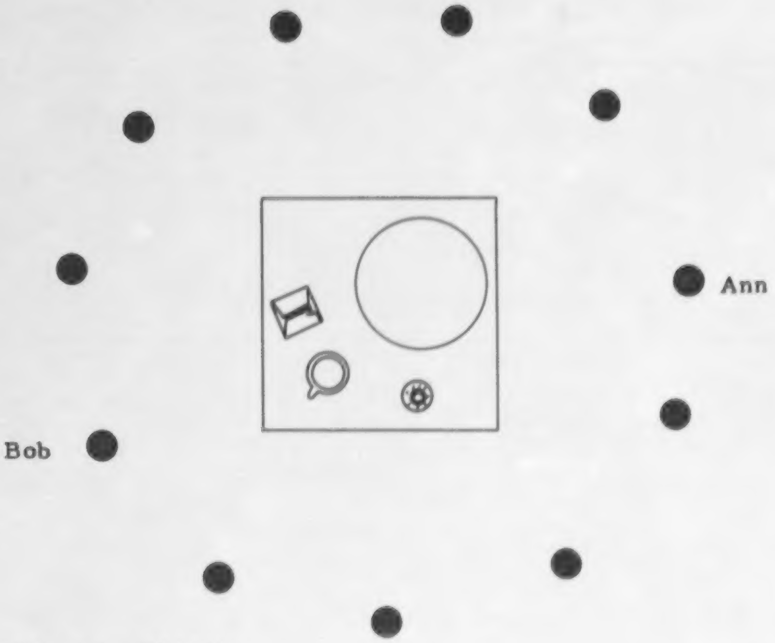
1. You should not replace these objects by any others since they are the ones that appear on the worksheets.
2. Each student should get only one of the first four worksheets. Try to organize it so that about one-fourth of the students get the same worksheet. Later in the lesson, everyone should be given Worksheet K101-V (aerial view).

ORGANIZATION OF THE CLASSROOM:

Place the four objects on a low table or desk in exactly the same relative positions as those shown in the "aerial" view of Worksheet K101-V (see the reduced copy below). It is particularly important that you are careful about the orientation of the handle of the coffee mug.

Seat the children in a circle around the table, about two meters away from it. The objects should be at about eye-level for the children.

K101



DESCRIPTION OF LESSON:

T: What do you see on the table?

Let the children describe what they see.

T: Do these objects look the same to all of us?

Whatever the reaction is, continue by asking:

T: Do the objects look the same to Ann as they do to Bob[**]?

Whatever the reaction is, let Ann and Bob describe what they see. In order to get a precise description, you might have to help them with this. In our

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[**] Choose two children who are seated opposite each other, as in the picture above.

seating (as shown above), for example, Ann could say:

Ann: I can see the ball.

T: Is the ball on your right or on your left?

Ann: It's on my right. And the bottle is on my left.

As Ann is speaking, make a sketch on the board of what she sees.

T: Can you see the milk carton?

Ann: No, but I can see the cup.

T: Where is the cup?

Ann: Behind the ball.

T: Can you see the whole cup?

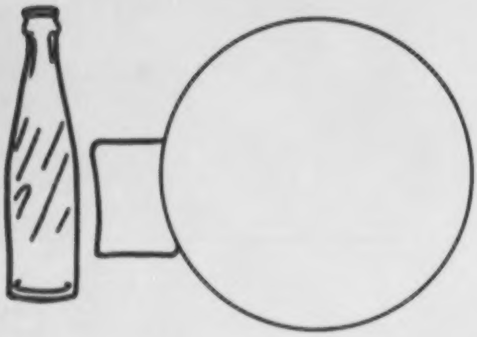
Ann: No.

T: Can you see the handle of the cup?

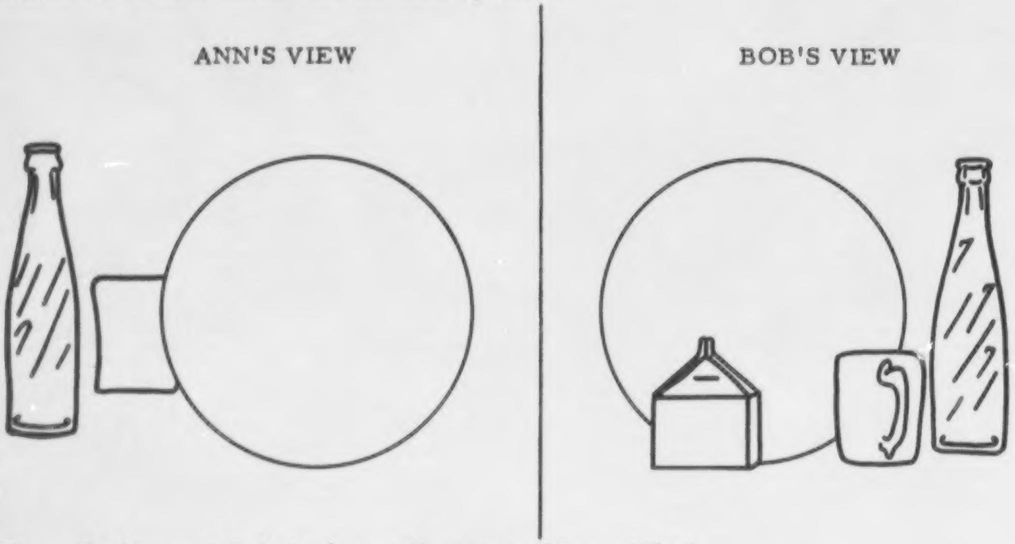
Ann: Yes. Well, at least, part of it.

T: On the board, I have drawn what Ann can see.

You should have a drawing similar to the following on the board:



Now let Bob describe what he sees. In our seating, Bob's description should lead to the following drawing, after completion of which you will have both Ann's and Bob's views[*] drawn side by side:



ANN'S VIEW

BOB'S VIEW

T: So Ann and Bob don't see the same thing. Why?

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[*] Of course, the actual drawings you will have on the board will depend on the positions of the two children you choose.

Accept any answer to the effect that what you see depends on where you are when you look. Make this point very clear. If you think it necessary, you could repeat the above activity with two other children, seated somewhere else in the circle.

T: Now I am going to give each of you a worksheet. On it you will find a picture of the four objects on this table. Not everyone will get the same picture. In fact there are four different pictures, taken from four different places.

Draw a large circle on the floor, around the table, about two meters away from it.

T: I would like each of you to walk around the circle. When you find a spot from which you can see the four objects in exactly the same way as they are shown in your picture, stop.

Distribute Worksheets K101-I, II, III, IV (see Note #2 above).

Don't be surprised if it takes the children quite some time to find the right spot. So be patient, and ready to discuss the problem!

When everyone has found the place from which the picture he or she received was taken, distribute Worksheet K101-V to everyone.

T: Can anyone find out where this picture was taken from?

The picture on Worksheet K101-V is taken from above the four objects. If necessary, give the children a chance to view the objects from on top, and see how things look from there.

TITLE: Number Readiness #12

SUGGESTED ACTIVITIES (see the introduction to Lesson K3):

A. What Happened?

MATERIALS:

Teacher - About 10 similar objects* (say, bricks;* or, failing anything else, you could use demonstration Minicomputer checkers on the magnetic board); a large paper bag*

Students - None

DESCRIPTION OF ACTIVITY:

Seat the students in a circle and place five of the objects in the middle.

T: How many are there?

S: Five.

T: Close your eyes.

Remove two of the objects and place them in your paper bag.

T: Open your eyes. What happened?

S: You took some away.

S: Yes; two of them.

Return the two objects so that there are five again.

T: Close your eyes again.

Add a sixth object.

T: Open your eyes. What happened?

S: There is one more.

Remove the object you just added so that there are five again.

T: Close your eyes again.

Remove one object, but spread the others out; that is,

go from: ● ● ● ● ●

to: ● ● ● ●

T: You can open your eyes again.

S: Only four. One has gone.

If this activity is going well, you could increase the difficulty by starting it again, this time using a basic group of eight objects.

B. Completing Numeral Charts

MATERIALS:

Teacher - None

Students - Worksheets K102-I, II, III, IV, V

DESCRIPTION OF ACTIVITY:

You should start every student on Worksheet K102-I. When a student finishes that worksheet, he or she should be given Worksheet K102-II, and so on (unless you feel the child is tired). Only the more advanced students should attempt Worksheet K102-V. Students working on that worksheet should sit in front of the 0-99 Numeral Chart as they perform this task. Be sure to read the directions to each worksheet out loud for your students.

EARLY WARNING:

You might want to use an overhead projector in Lesson K103. If so you should make any necessary arrangements beforehand.

K103

TITLE: "So Alone"

MATERIALS:

Teacher - Colored chalk* (or an overhead projector* and pens* for writing on transparencies)

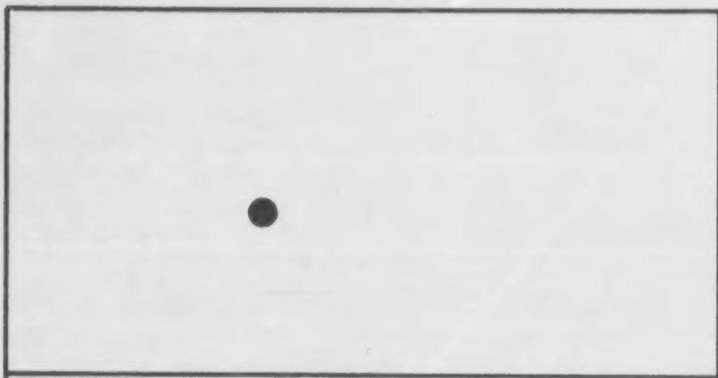
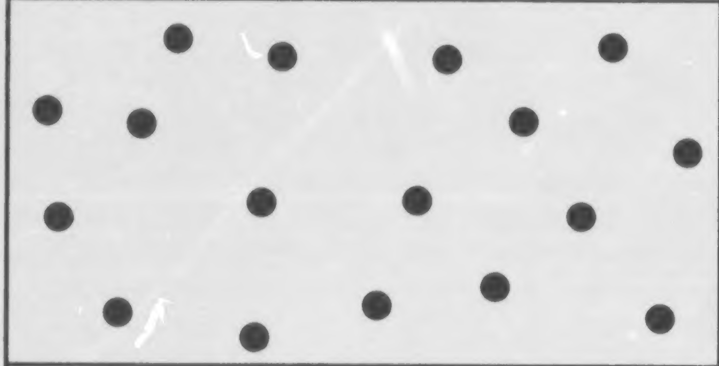
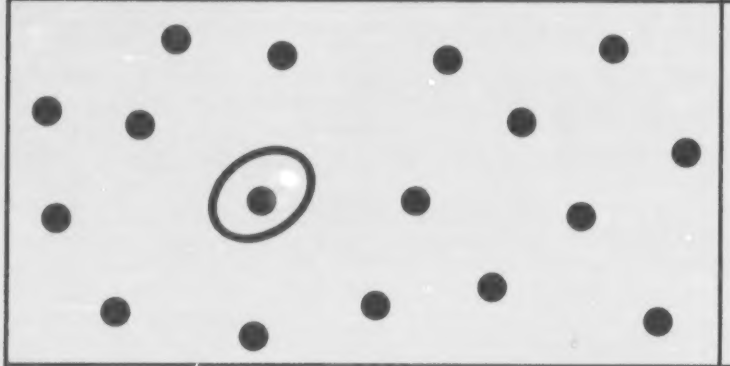
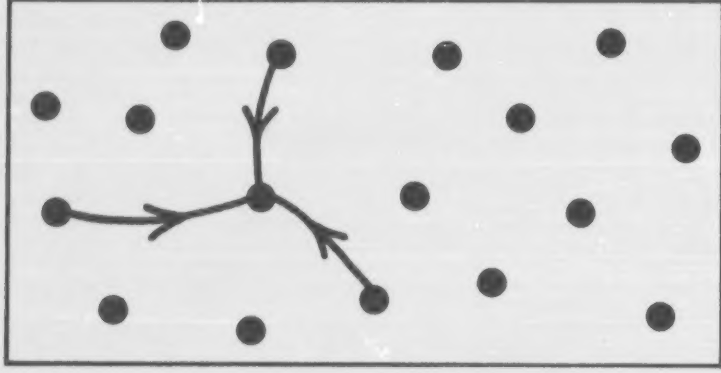
Students - None

DESCRIPTION OF LESSON:

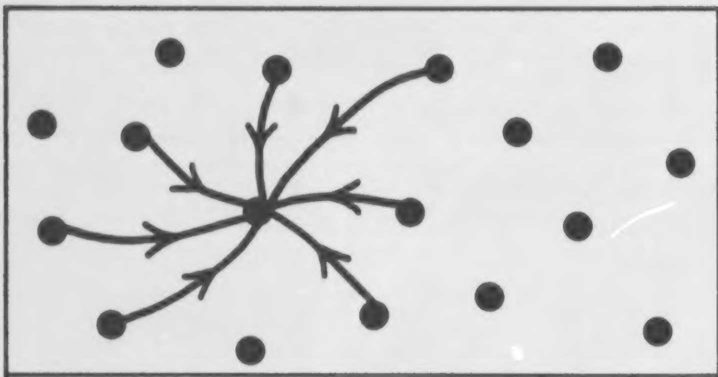
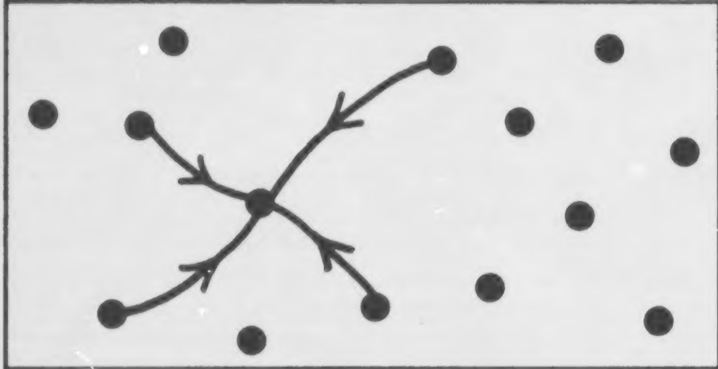
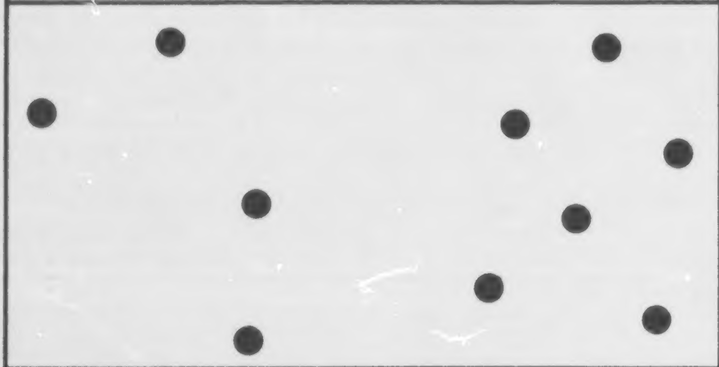
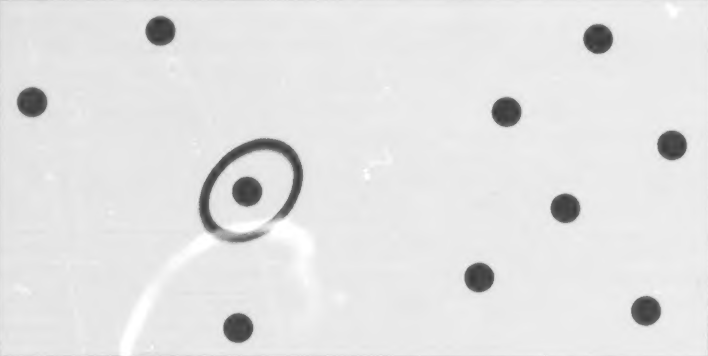
"So Alone" uses the nonverbal languages of dots, arrows and strings to tell a story of loneliness and love, which may strike a chord for many of your students. The pictures are simple enough that they can be drawn on the board as you read the story. To help you do this, we have provided you with a succession of pictures, just as if it were a filmstrip. You should not draw such a sequence of pictures for your children. Instead, you should draw the first picture and tell the first part of the story. Next add all the extra dots and tell that part of the story. Then add the green string. At each stage, make as minor a modification of your picture as possible so that it ends up looking like the corresponding "frame" in this description.

Remember to make a large, clear drawing, with big dots, long and easily visible arrows, thick strings (draw them with the side of a small piece of chalk or by using a thick visual aid pen).

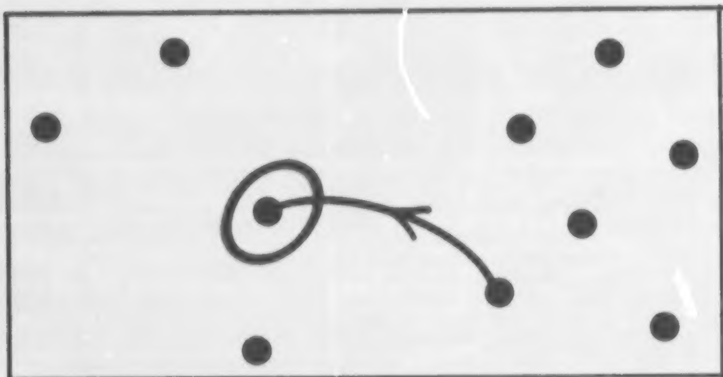
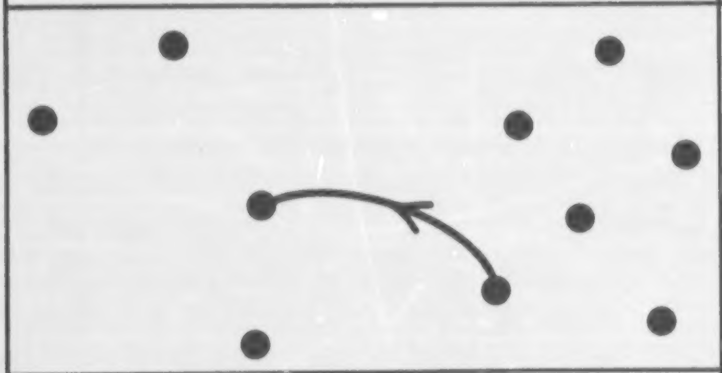
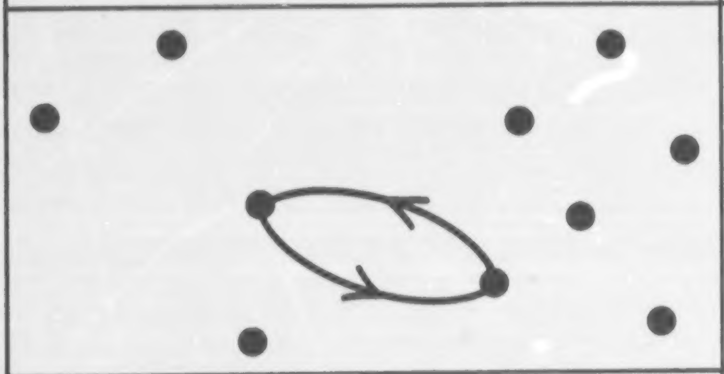
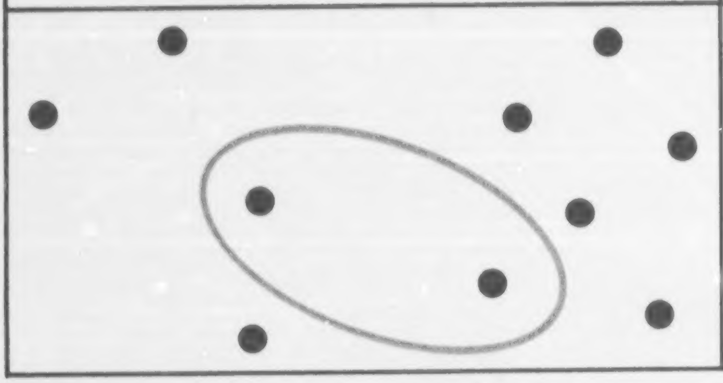
K103

	So alone.
	Everyone in the crowd looks the same.
	I want to be noticed. What can I do? I begin to cry.
	Several people look at me.

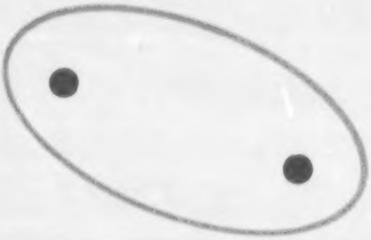
K103

	I cry louder. The louder I cry, the more attention I get.
	People get tired of hearing me cry. They start to leave.
	Everyone looks the same again.
	Now I have some nice thoughts; beautiful warm feelings. My eyes must be sparkling!

K103

	Someone smiles at me.
	I don't feel alone any more.
	We share a warm feeling.
	Together we are happy.

K103

	All the others seem to disappear. There are just the two of us.
	Now when I am by myself I remember the warm feelings we share.

When you have finished telling this story, don't rush the children into another activity. Instead, make them feel free to talk about the story (with you or with a friend), or to make a drawing about it if they wish.

TITLE: Detective Story #2

MATERIALS:

Teacher - One demonstration Minicomputer board; a piece of paper* with the numeral "4" written on it (for Story 1); a piece of paper* with the numeral "9" written on it (for Story 2)

Students - None

DESCRIPTION OF LESSON:

Story 1:

T: I have a secret number friend whose name is on this piece of paper. My friend has given me some clues to help you find out which number it is.

CLUE 1: You will find me if you count by twos (or skip-count) from 0 to 20.

What could my number be?

Let someone skip-count from 0 to 20 while you record on the board:

0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

T: Here's the second clue: My number says,

CLUE 2: I am smaller than 10.

Let the children react to this clue.

S: The number could be 8.

S: It could not be 20.

If necessary, ask questions such as:

T: Could my number be 10?

S: No.

As the children eliminate a number, cross it off your list. When this process of elimination is complete, erase all the crossed out numerals, leaving the following on the board:

0, 2, 4, 6, 8

T: Here's the third clue: My number says,

> CLUE 3: I am on this Minicomputer,
> using just one invisible checker.

T: Could my number be 0? (No. Cross "0" off the list.)

Could my number be 2? (Yes. Let a student come to the board and use his or her finger to show where the invisible checker would be.)

Could my number be 4? (Yes.)

Could my number be 6? (No. That needs two checkers.)

Could my number be 8? (Yes.)

At this stage you should have the following on the board:

2, 4,   8

T: Here's the fourth clue: My number says,

> CLUE 4: Look at the board: Three numbers are left. I am not the smallest one; I am not the largest one. I am . . .

S: Four.

Unfold your piece of paper and show everyone that indeed you do have "4" written on it.

Most children love these detective stories and ask for more. So here is another one.

Story 2:

T: I know another secret number, whose name I have written on this piece of paper. Here's the first clue: My number says,

> CLUE 1: You will find me if you count by twos from 1 to 19.

What could my number be?

Let someone skip-count from 1 to 19 while you record on the board:

1, 3, 5, 7, 9, 11, 13, 15, 17, 19

T: Here's the second clue: My number says,

CLUE 2: I am smaller than 10.

As in the first story, let the children react to this clue. As they eliminate numbers, cross them off your list.

You will be left with the following on the board:

1, 3, 5, 7, 9

T: Here's the third clue: My number says,

CLUE 3: I am on this Minicomputer,
using two invisible checkers.

Once again, let the children react to this clue.

S: The number could not be 1. (Cross "1" off the list.)

S: It could be 3. (Let a student come to the board and use his or her finger to show where the two invisible checkers would be.)

S: It could be 4.

T: It is true that we can show 4 on the Minicomputer using two checkers. You are right, but we already know that our number is one of these numbers (point to the numerals remaining in your list on the board).

If necessary, ask:

T: Could my number be 5? (Yes. Let someone use his or her fingers to show where the checkers would be.)

Could my number be 7? (No. Cross "7" off your list.)

Could my number be 9? (Yes)

You should now be left with the following on the board:

3, 5, 9

T: Here's the fourth clue: My number says,

CLUE 4: You cannot show me with the fingers of one hand.

Once again, let the children react to this clue. If necessary, ask:

T: Could my number be 3? (No. Cross "3" off your list.)

Could my number be 5? (No. Cross "5" off your list.)

Could my number be 9? (Yes)

The only thing left on the board should be:

9

Unfold your piece of paper and show your children the "9" written on it.

EARLY WARNING:

In Lesson K105 you will need a pair of scissors for yourself and a pair for each student.

480

K105

TITLE: Mirror Symmetry #5

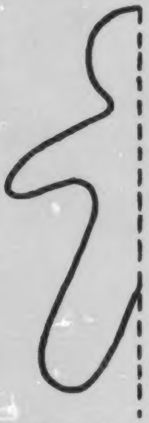
MATERIALS:

Teacher - A large sheet of paper*; scotch tape*; chalk* or a large magic marker*; a pair of scissors*

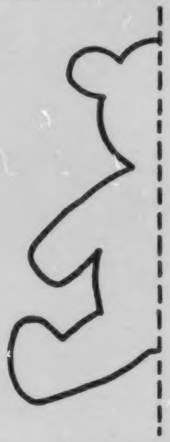
Students - Worksheets K105-I, II, III, IV, V; a pencil*; a pair of scissors*

DESCRIPTION OF LESSON:

Tape the sheet of paper onto the chalkboard and on it draw one-half of a simple, familiar design (for example, a gingerbread man or a teddy bear).



OR



T: I am thinking of a picture, but on this piece of paper I have only drawn half of it. Let's pretend that we place a mirror along the dotted line. Then, by looking in the mirror, we could see the whole drawing. Try to see the whole picture in your mind. What is it?

S: A gingerbread man (a teddy bear).

Let several children come to the board and trace the missing half (but don't actually draw it).

T: I would like to cut my picture out, but I want the whole picture, not just half. What could I do?

The most accurate way to do this is to fold the piece of paper along the dotted line, and then cut both layers at once following the lines of the half-picture. If no one makes this suggestion, do so yourself, and then cut out the gingerbread man (or teddy bear) using this method.

Distribute copies of Worksheet K105-I. For each of the five worksheets which go with this lesson, the tasks are as follows:

- to imagine the other half of the picture which would appear if a mirror were to be placed along the dotted line
- to draw what it is imagined this other half looks like
- to fold the worksheet along the dotted line and cut out the picture
- to compare the part of the picture that was added by hand with the corresponding part of the cutout.

When a student finishes Worksheet K105-I, he or she should be given Worksheet K105-II, and so on.

These worksheets start with very simple pictures (such as a kite) and work up to more complicated ones (turtles, flowers). Not everyone should be expected to do all five of the worksheets. Any worksheets which remain after the lesson could be given as individual work at any time during the remainder of the school year to those children who enjoy this kind of activity.

K106

TITLE: Introduction to the Minicomputer #4

MATERIALS:

Teacher - Two demonstration Minicomputer boards; demonstration Minicomputer checkers; colored chalk*

Students - None

IMPORTANT NOTE:

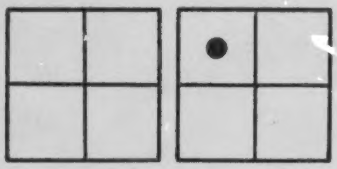
Before teaching this lesson it would be advisable for you to re-read Lesson K80: Introduction to the Minicomputer #1.

DESCRIPTION OF LESSON:

Draw the children's attention to the two Minicomputer boards mounted on your magnetic board, and let them explain what they remember about the Minicomputer.

Activity 1:

This should be a very short activity. Place one checker on the brown square of the first board:



T: What number is this?

S: Eight.

In a similar fashion, review the Minicomputer way of writing 1, 2, 4.

Activity 2:

This should also be a very short activity.

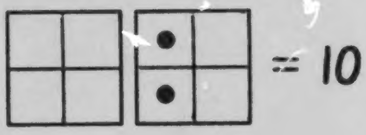
T: Who could come here and write the number 3 on the Minicomputer?

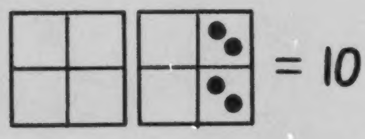
Ask similar questions for the numbers 5, 6, and 7 (see Lesson K80 for the answers).

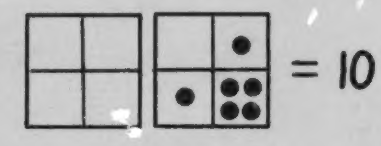
Activity 3:

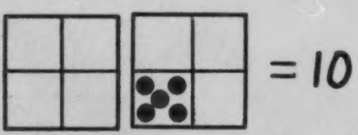
T: Show me ten fingers. Can someone write the number 10 on the Minicomputer?

When this has been done, ask for other ways to write 10 on the Minicomputer. There are several correct answers. We provide some of them below:





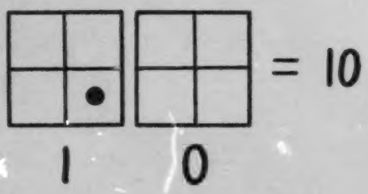




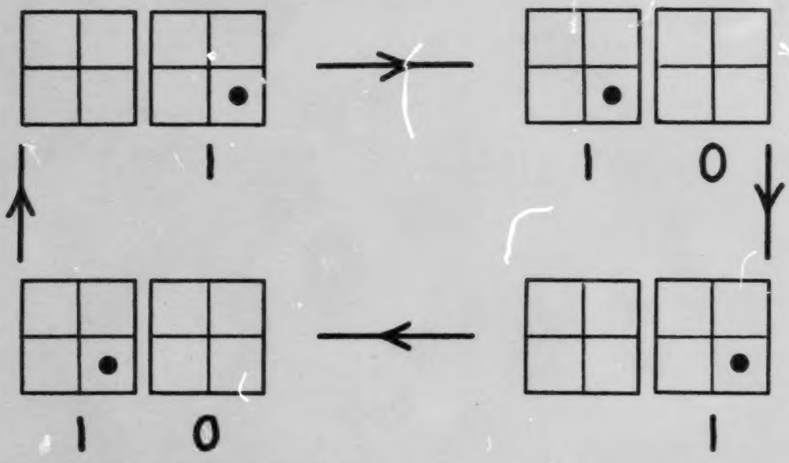
When a child suggests a way to write 10, you should ask the other children to check it using one of the "checking techniques" that were described in Lesson K80.

T[**]: So far we've found several ways to write the number 10 on the Minicomputer. Now, here is another way that uses just one checker.

Place one checker on the white square of the second board, and write "10" beneath the boards, lining each digit up beneath its corresponding board:



Now move the checker back and forth from one white square to the other, while the children say at each stage what number is written on the Minicomputer.



[**] If in Lesson K80 you reached the stage of introducing this way of writing 10 on the Minicomputer, then instead of making this statement you should ask the children if they remember how to write 10 on the Minicomputer using only one checker.

In many classes the discovery of this way of writing 10 is "explosive," and the children are very eager to use it. For example, a child might burst out and say,

S: I can do 14.

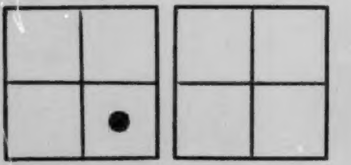
Or a child's curiosity might be sparked:

S (placing a checker on some other square of the second board): What number is this?

Be ready to go along with this youthful enthusiasm.

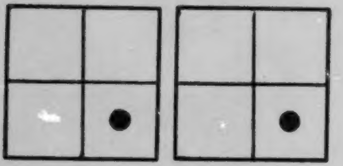
The following dialogue should be viewed merely as an example of what might happen. Almost certainly your students will react differently. We emphasize that you should be led by their interest; do not try to impose the direction described here.

T: Here is 10.

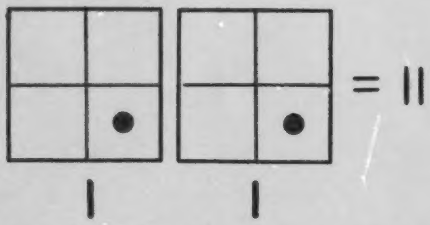


T: Who can write 11?

S:

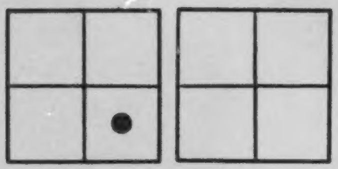


Write the numeral beneath the boards:



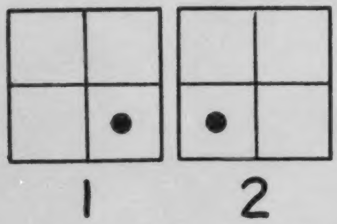
This writing should be done in as casual a way as possible. Simply write; don't say anything! (After a while you could let the children do the writing as well as placing the checkers.)

Write 10 on the Minicomputer again.



T: Here is 10. Who can write 12 on the Minicomputer?

The answers you are most likely to get are:*



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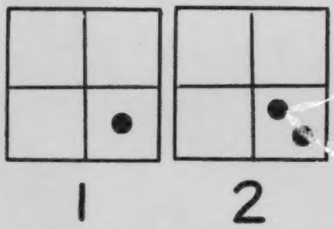


T (pointing to one of these two representations): Here is 12. Can someone write 13 on the Minicomputer?

Continue in this way for as long as your students are interested.

---

* It is possible to write 12 using only the first board ("8 + 4" or "6 x 2" for instance). Accept these answers if someone does suggest them but lay the greater emphasis on the standard representation "10 + 2."

TITLE: The Young Artists

MATERIALS:

Teacher - Colored chalk*

Students - None

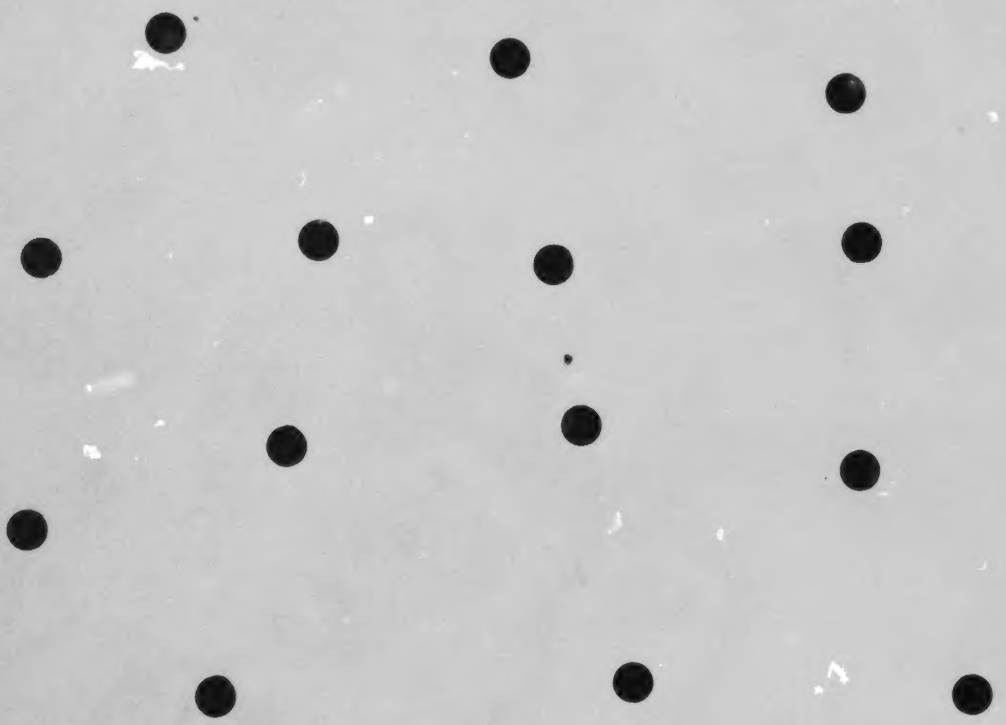
IMPORTANT NOTE:

Remember to make a large, well-spaced, attractive, clear drawing.

DESCRIPTION OF LESSON:

Draw 14 dots on the board as follows, while you say:

T: These dots are for the students who were in my class last year.



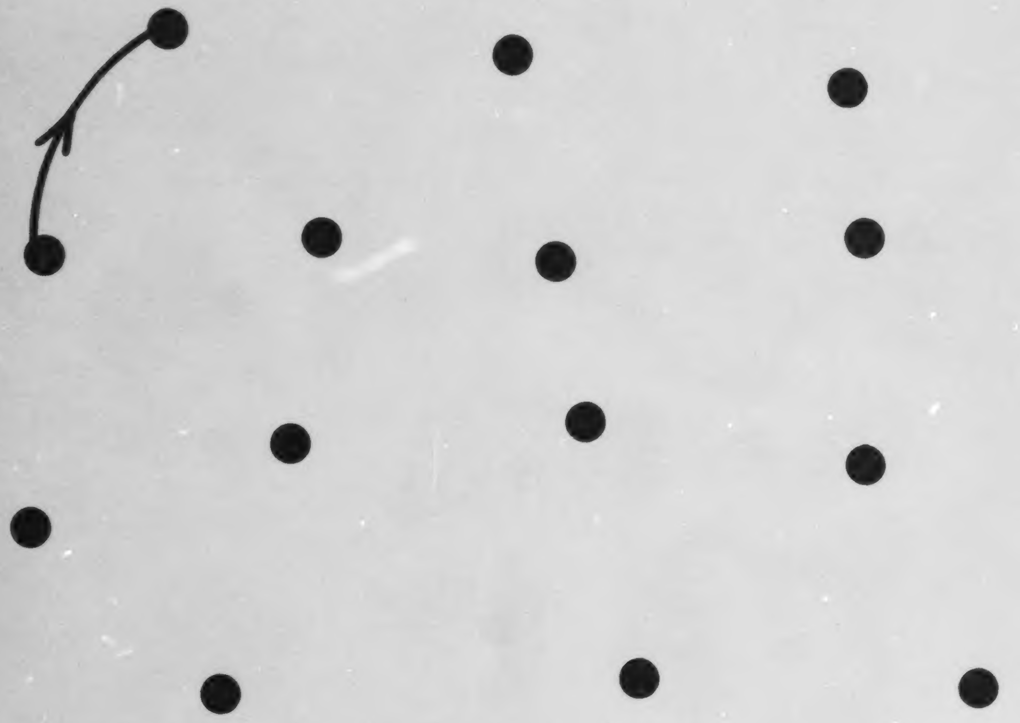
K107

T: How many children were there in my class?

Let someone count the dots, point to "14" in the Numeral Row, and write "14" on the board.

T: These children loved to draw pictures. One day, I gave each of them a piece of paper and I told them to draw a picture that involved one or more of the pupils in the class.

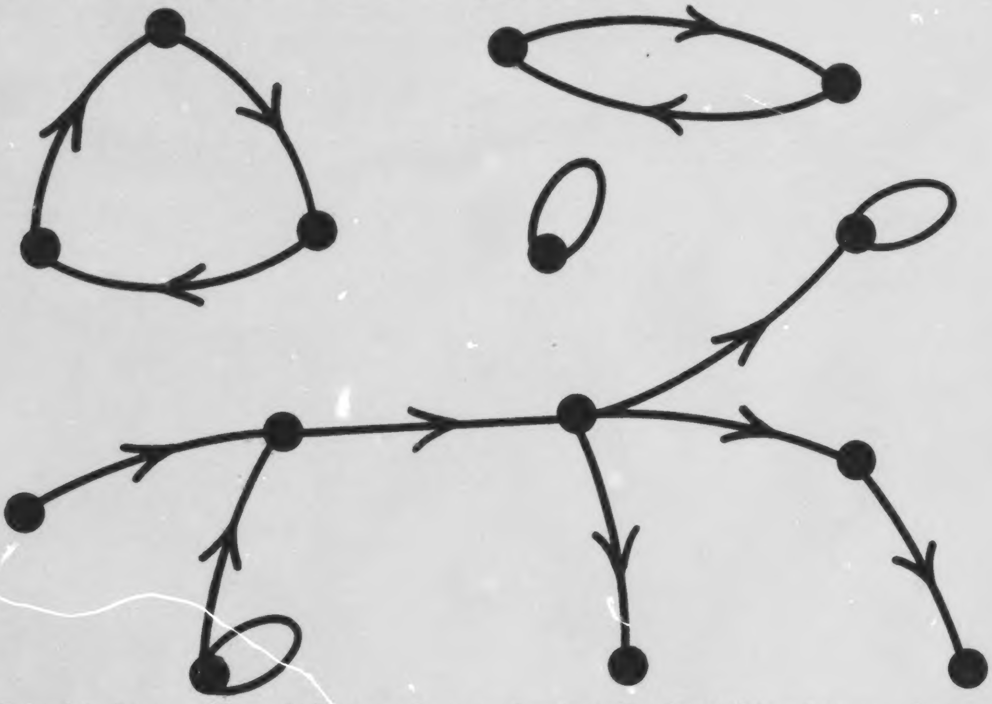
Draw one red arrow,



and say:

T: This child says to this one, "You are in my picture."

Let someone point to the child who is doing the drawing, and someone else point to the "model." Then complete the picture slowly; tell the children to watch carefully as you draw, and to think about the story. Remind them that the red arrow means: "You are in my picture."



Your students will probably need no urging to talk about this picture. Leave them free to do so. Here are some remarks which might be made:

S: These two children are in each other's picture.

S: They must be very good friends.

S: Look at that one. He is drawing a picture of himself.

and so on.

To complete this lesson you could choose among the following questions:

T: Are there some children who are drawing pictures with several of their friends in them? (Yes)

Are some children not drawing any picture at all? (Yes)

Can you find someone who is not in anybody's picture at all? (Yes)

Can you find someone who is drawing a picture with only one person in it? (Yes)

What about this child? (Point to one of the dots with a loop. That person is drawing a picture in which he or she features.)

Are there any other children who decided to draw a picture with themselves in it? (Yes)

EARLY WARNING:

For Lesson K108 you will need a very large sheet of paper (for instance, a length cut from a roll of wallpaper), some glue, and several small colored paper rectangles for each child.

TITLE: Number Collage #2

MATERIALS:

Teacher - A very large piece of paper* (for instance, a length cut from a roll of wallpaper); glue*

Students - Several small paper rectangles* for each child (use paper of various colors and sizes); colored crayons*, felt tip pens* or finger paint*

IMPORTANT NOTE:

In this lesson, the children are to make a collage out of different names for the number 10.[**] If your class is familiar with collage activities, organize this activity as you usually do.

DESCRIPTION OF LESSON:

Give each child several small paper rectangles. On each piece they should write or draw a representation of the number 10. For example, they could draw ten dots in various positions; they could draw a Minicomputer and write 10 on it; they could write " 10" or "Ten"; they could write various other names for 10, such as "5 + 5" or "8 + 2." You may want to give some examples on the board before the children start, but be sure to urge your children to use their imaginations!

When everyone has finished writing and drawing, let the children take turns to glue their pieces of paper onto the large sheet.

[**] If you think this might be too hard for most of your students, use the number 5 instead.

Section Four:

SUPPLEMENTARY ACTIVITIES

SI NUMERAL-WRITING

Children need to learn how to write numerals, and this goal is only to be realized through practice. We all agree about that. However, you will not find very many "numeral-writing worksheets" in this curriculum. When a child has to write a page full of "2's," the first attempts may be awkward, then they begin to look better; but very soon they start looking peculiar again as the task begins to bore the student. Surely this is not a very efficient way to learn!

Writing numerals is a mechanical task, just like shifting gears in an automobile. No one should have to go through the motions of shifting gears twenty times before even starting the engine! It is something that is learned as you drive; and the more you drive the more proficient you become at shifting gears. We suggest that the same principle be applied in the teaching of numeral-writing; it should occur as part of a larger learning experience.

Whenever the occasion arises ask the students to use their fingers to trace a given numeral on their desks; to write it on the chalkboard, or on a piece of paper.

As a model, show them the appropriate demonstration numeral card* or demonstration multicolor numeral card.**

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* The set of these numeral cards should be on permanent display in the classroom as a Numeral Row. (See Section Two of this guide: "Numbers Are Everywhere . . . Or Should Be.")

** These are packaged with the demonstration numeral cards.

It may be that some of your students need more practice than they can obtain from these rather casual exercises. In that case, the following activities may well provide the additional practice they need.

Activity 1: No Pencil.

MATERIALS:

Various (see the description of the activity)

DESCRIPTION OF ACTIVITY:

Many children go through phases during which they simply love to write numerals. Take advantage of these phases. As a pleasant change, allow your students to draw (or make) numerals in unusual ways and using unusual media. Your imagination is just about the only thing that will limit what can be done!

For example, you could ask the children

- to write giant numerals on a huge piece of paper using a fat felt tip pen
- to write numerals on the chalkboard with colored chalk
- to trace numerals in a tray of sugar, a dish of chocolate pudding, a sandbox, ...
- to draw numerals with frosting on a piece of paper or (even better) on a cookie
- to mold a numeral out of Play-Doh or extra stiff (add additional flour) cookie dough.**

** Be sure to bake these, and let the children eat them!

Most of the time you should let each child choose which numeral he or she wants to make (at a given moment some particular numbers might be special to that child!).

Be sure to provide a good model for the children to work from (the demonstration numeral cards or demonstration multicolor numeral cards.

Activity 2: Feel The Numeral.

MATERIALS:

Teacher - A pencil* with an eraser, or a lip-stick,* or an eye shadow pencil,* etc.

Students - None

DESCRIPTION OF ACTIVITY:

Write a numeral on the palm of a child's hand with an eraser, a lip-stick, or eye shadow pencil, or something else of your choosing. The child's task is to identify the numeral without looking at his or her palm.

Activity 3: Feel and Write.

MATERIALS:

Teacher - None

Students - Chalk*

DESCRIPTION OF ACTIVITY:

Ask a child to stand in front of the chalkboard. Trace a numeral on his or her back with your finger. The child is to write the same numeral in chalk on the board.

The first time you do this activity you should tell the child which numeral you are writing. Later on it might be fun to let him or her figure it out only by the way it feels.

Activity 4: Write and Draw.

This activity is described in Lesson K21-2.

You should feel free to repeat it several times. Be careful to avoid the monotony of dealing with the number 1 the first time you do this activity, the number 2 the second time, and so on.

Activity 5: Number Collages.

This type of activity is described in Lessons K26 and K108.

Activity 6: Santa's Shed.

On the following pages you will find the raw material from which you can construct a workbook (called "Santa's Shed") that is intended for those students who need practice at numeral recognition and writing.

We suggest that you draw enlargements of the pictures (with thick strings, big dots and big numerals), one picture to a sheet of paper. (Take care that on pages 1, 2, and 8 the dots are in the same position.) Leave the back of each page blank so that you don't have two pictures facing each other. If you wanted to, you could bind the pages together (with a stapler, for example) to form a little booklet.

This workbook is designed so that a child can work with it alone, or a small group of children can work with it together. To that end, there is a narration tape[*] available so that such children will not require your assistance in order to be able to benefit from this workbook.

The text that we show running parallel with the pictures should not be reproduced in the workbook that you make. It is there so that you can provide the narration for the children if you choose not to order the narration tape.

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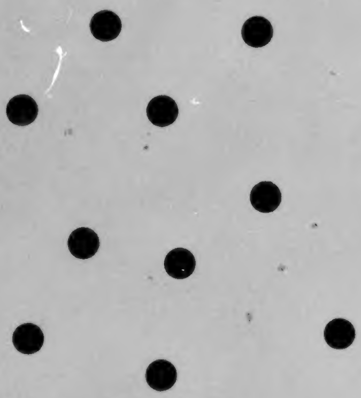
[*] This tape may be obtained by sending a blank 30-minute cassette tape to CEMREL-CSMP. The recorded tape will be returned to you free of charge. Please be sure to mention the title of this workbook in your request for the tape to be recorded, and include a stamped, self-addressed envelope.

Santa's Shed

Did you know that Santa has a marvelous garden? At the bottom of that garden there is a shed where he keeps all the toys that he didn't give away at Christmas.

Today you are invited to pay a visit to Santa's shed.

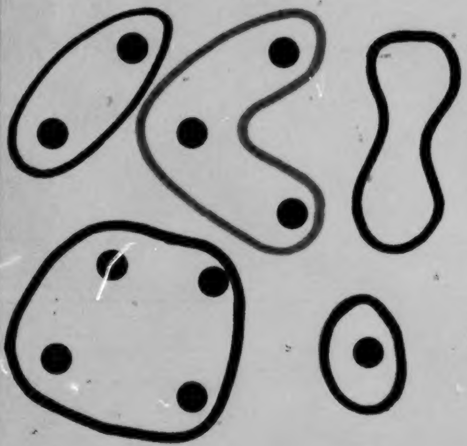


Hello! We are all toys.

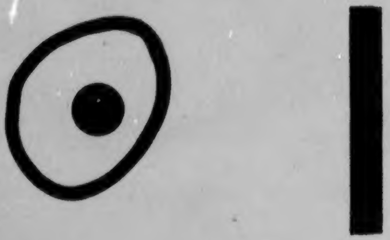
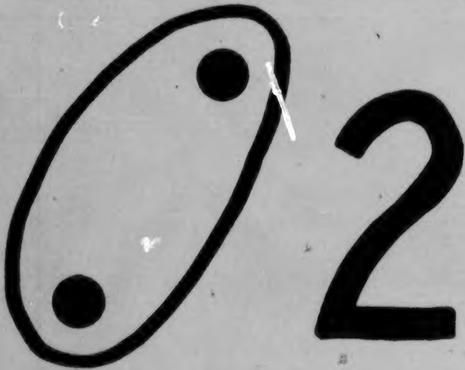
Can you count how many there are of us?

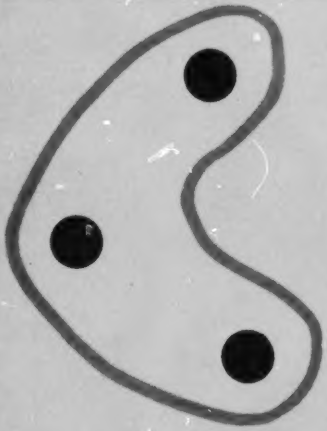
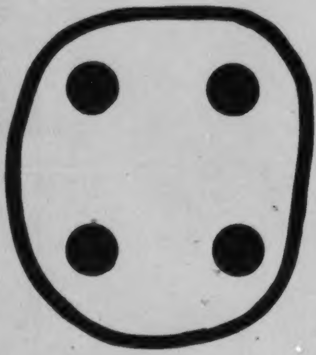
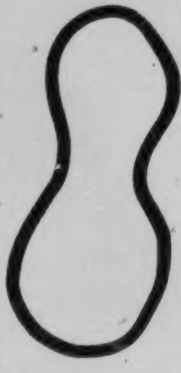
Touch the dots as we count them together:

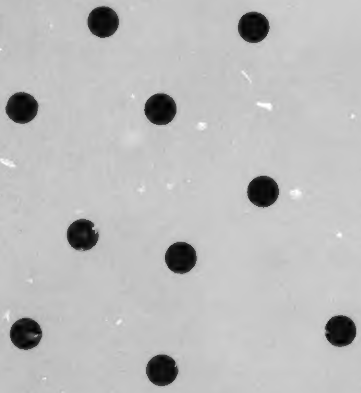
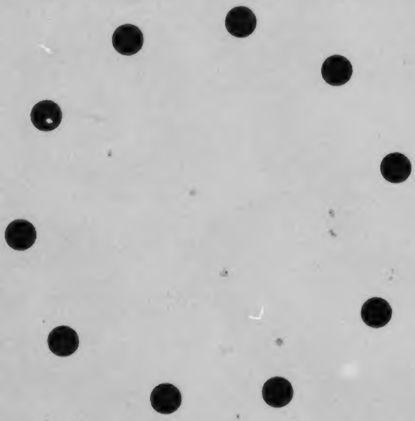
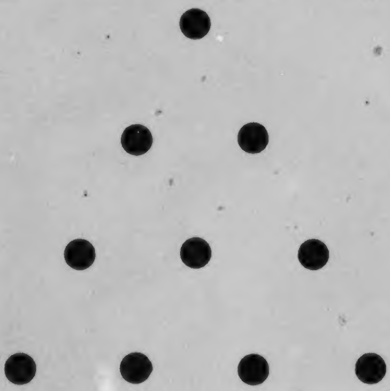
Ten dots. There are ten toys in Santa's shed.

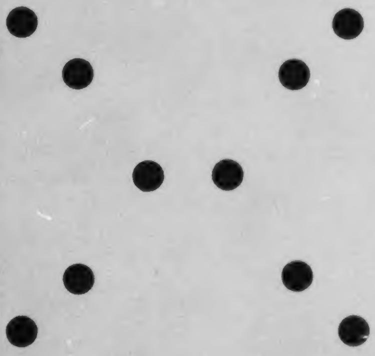
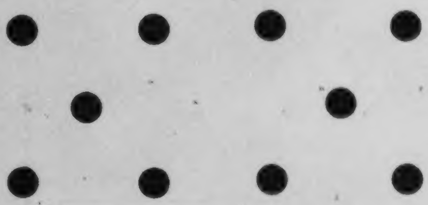
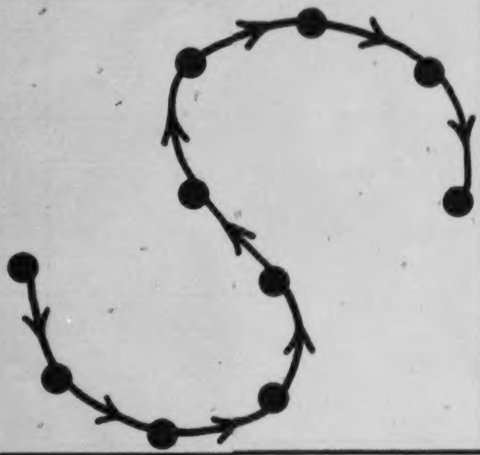


Look what has happened!
Santa wanted to tidy up his shed. So he put the toys away on shelves so that on each shelf all the toys are alike. I have drawn some strings to show you which toys are together on the same shelf.
All the dolls, and nothing else are in this yellow string. How many of them are there?
There are exactly two puppets.
Point to each of them with your finger.
The dots in the purple string are for wooden horses. How many of them

	are there? There is only one teddy bear in Santa's shed. That's me. Point to me with your finger. This year Santa had no toy cars left after Christmas. That's why the blue string is empty.
	One bear. Point to the dot and write the number one with your finger.
	Two puppets. Point to the two dots and write the number two with your finger.

 3	Three dolls. Point to the three dots and write the number three with your finger.
 4	Four wooden horses. Point to the four dots and write the number four with your finger.
 0	No toy cars. Point to the empty string and write the number zero with your finger.

	Ten toys. All day long we stay very still and quiet on our shelves. But at night we become alive. We go out of the shed into the garden to play in the moonlight. Do you remember how many of us there are? Ten. Let's count together again.
	The ten of us have a lot of fun together, as we dance and jump around . . .
	. . . or as we march in line as if we were in a parade . . .

	. . . or as we chat together two by two . . .
	. . . or as we play softball in teams of five . . .
	. . . or as we run around one behind the other. Count us once again.

10	Yes, there are ten of us.

Activity 7: Numeral-Writing Worksheets.

Some supplementary worksheets are provided at the back of each worksheet pad. You should use them extremely sparingly, giving them only to those children who are experiencing the utmost difficulty with writing numerals.

A COLLECTION OF HELPFUL HINTS

- When a child claims that he or she cannot write a certain numeral, there are various courses of action open to you. Among the most helpful is for you to write the numeral on the child's piece of paper or on the chalkboard and ask the student to copy it. While he or she is trying to do this, do not guide the child's hand, particularly when a "0," "8," or "9" is involved. (There are two possible directions that can be taken when writing these numerals, and which one a child spontaneously uses seems to be connected with lateral dominance. There is no way for you to predict which way is most natural for a given child.)
- If you ever have cause (as described above) to demonstrate how to write a numeral, you may wish to recite a little verse as you do so. Here

are some possibilities:

0: Around and around and around we go;
That's the way to make a zero.
1: Draw a line and then you're done;
That's the way to make a one.
2: Around and back and then you're through;
That's the way to make a two.
3: Around a tree and around a tree;
That's the way to make a three.
4: Down and over and down once more;
That's the way to make a four.
5: Down and around and then a line;
That's Mr. Five, he looks so fine.
6: With a curving line a loop you mix;
That's the way to make a six.
7: Across the sky and down from heaven;
That's the way to make a seven.
8: In and out of two trees you go;
Back to the start; that's an eight, you know.
9: Draw a loop and draw a line;
That's the way to make a nine.

- "Mirror numerals" are not at all uncommon with very young children, and so you should not be concerned if any are produced in your class.

When a child writes a "mirror 5," for instance, just comment casually that usually we make "5's" facing the other way.

If you have any children who consistently reverse numerals, you might find demonstration multicolor numeral cards[*] to be very helpful as a model for numeral-writing. Instruct the students to copy the black part first, then the red part, and (in the case of "4" and "5") then the blue part.

- One last piece of advice: Be patient! Some students will write beautiful numerals right from the start. For others, that might not happen for quite some time. Whatever the case, there is a large quantity of interesting and meaningful number activities which do not require the writing of numerals.

---

[*] These are packaged with the demonstration numeral cards.

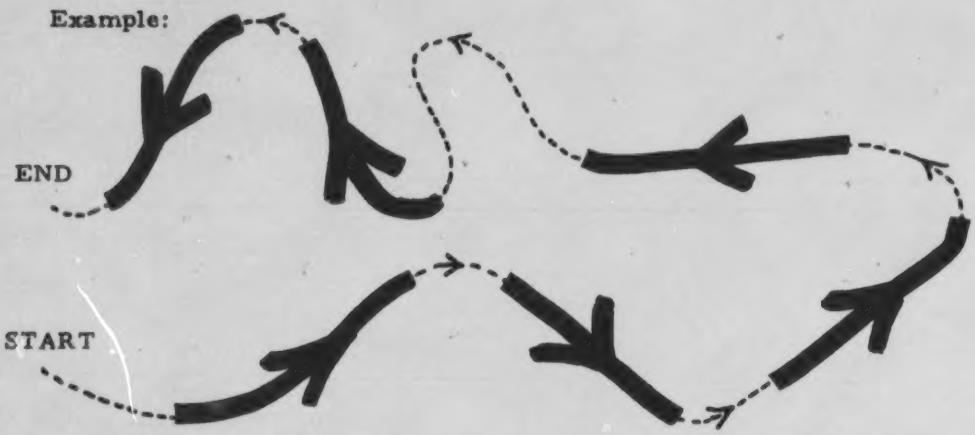
S2 ARROWS

Following Arrows

If any of your students need some additional help in following the sense of an arrow properly, you may find the following suggestions useful.

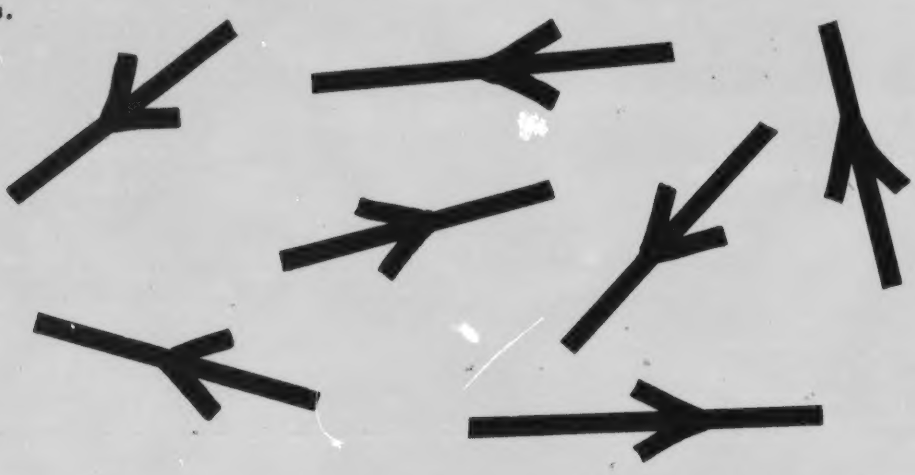
- Mark some arrow paths with colored tape on the floor to indicate regularly-traveled routes. For instance: from the board to the bookshelves and back, from the back of the room to the door; and so on.
- Draw large arrows with chalk on the playground. A student may start at the beginning of any arrow, but he or she must always follow the direction of that arrow. The object is to walk across all the arrows.

  Example:



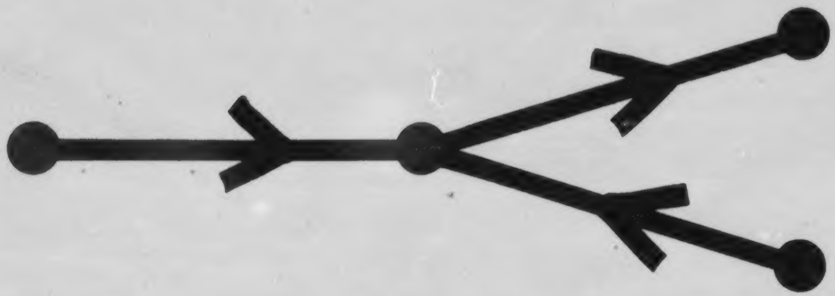
- Draw one large arrow on the chalkboard with the side of a brightly colored piece of chalk.

Explain that this is a one-way street. Using a small toy car demonstrate the way the car is supposed to go on this one-way street, without "bumping" into the point of the arrow. Add a lot of other arrows, all going in different directions.

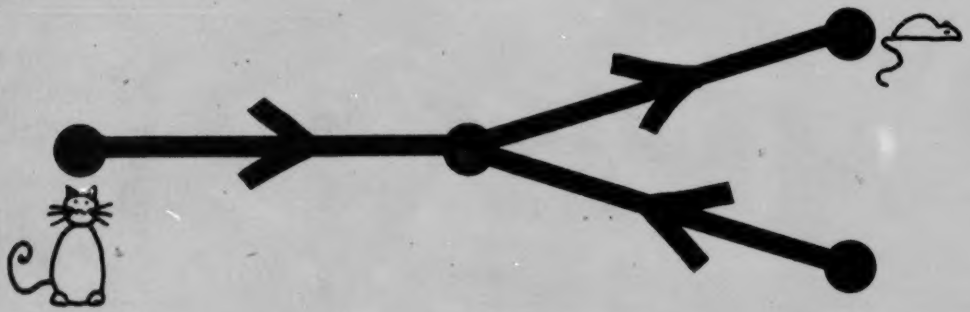


Ask a student to drive the toy car along each arrow in the correct direction. The rest of the class are policemen. Their job is to watch carefully and make sure the car doesn't go the wrong way down a street.

- Draw the following picture on the chalkboard. Again make large arrows.



Have available a small picture of a cat and one of a mouse. Tape each one beside one of the dots with masking tape:

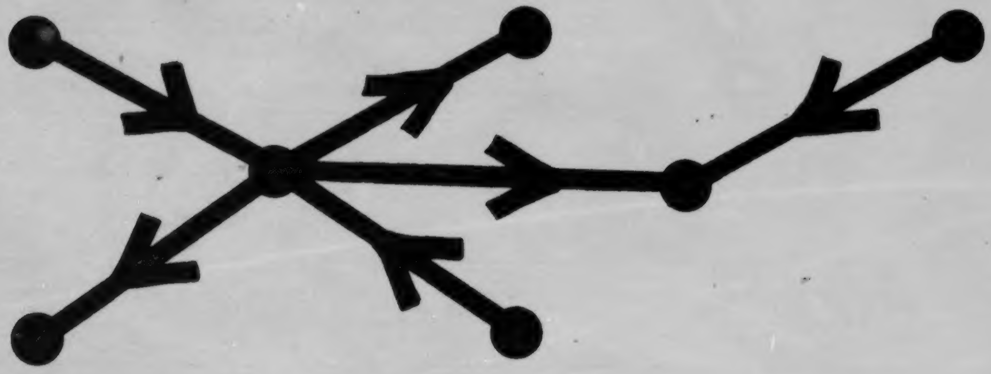


T: The cat has to follow the arrows. Do you think the cat can catch the mouse?

S: Yes.

Ask someone to demonstrate. Continue by moving the cat and the mouse to different dots. You can vary this activity by giving the two pictures to a student and asking him or her to place them so that the cat can (or cannot) catch the mouse.

- The previous activity can be repeated with more complicated arrow pictures. For instance:



Drawing Arrows

A youngster might be able to follow arrows perfectly, to trace them with his or her finger or with a pointer, to understand beautifully what is going on in an arrow picture, and yet still be unable to draw them correctly. Children usually acquire this last skill later than the previous ones. Forcing a student to draw an arrow picture when his or her motor coordination is not yet adequate for the task will just result in some very confused work involving a collection of sick-looking arrows. This will surely not improve the child's understanding of the mathematical concepts under consideration, and could easily leave both you and the child feeling deeply frustrated. When working with such a student, ask him or her to trace along a proposed arrow, after which you should do the actual drawing on the board yourself. Remember to make each arrow large, colorful, beautiful and clear.

The ability to draw arrows is not a prerequisite for the CSMP First Grade Program. Many of the early First Grade lessons can be very productive even if the children do no more than trace arrows for you to draw on the chalkboard. However, you might like your students to gain a little experience in this area. We suggest that a good time to do this would be during an art lesson, because in such a context your children will be free of any mathematical concerns and you will have the opportunity to praise a good layout, a sensitive choice of colors, and so on.

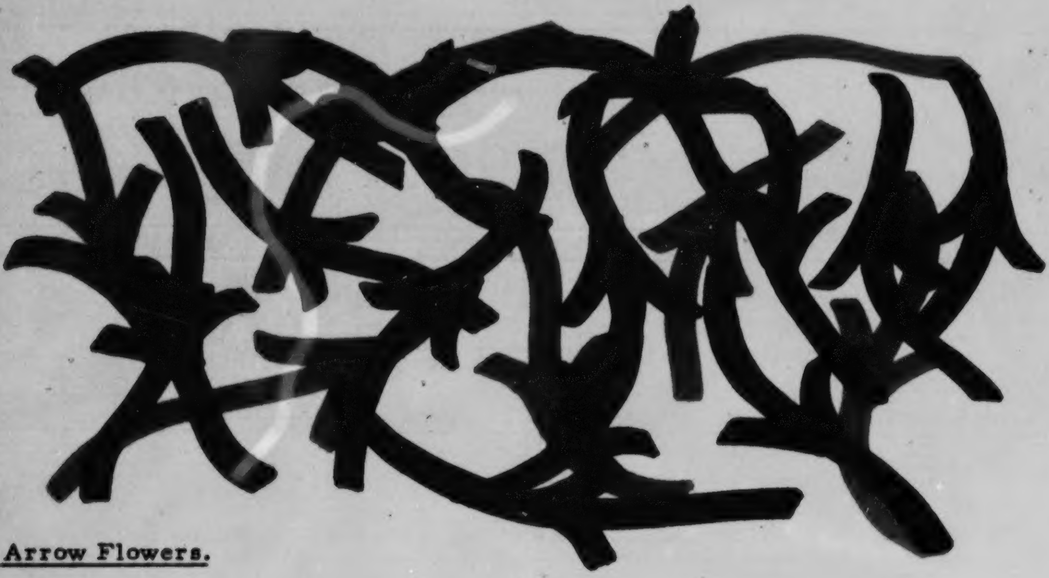
Here are some suggestions for such an art lesson:

Arrow Collage.

MATERIALS:

A large sheet of paper* (for example, a wallpaper sample) for each child or group of children; finger paint* or some fat felt tip pens*

The idea of this activity is for the children to make abstract pictures that are built out of colored arrows. Each child can work alone on his or her own picture, or several children can work together on the same picture.

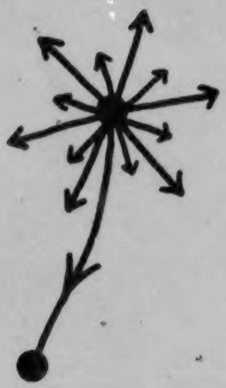


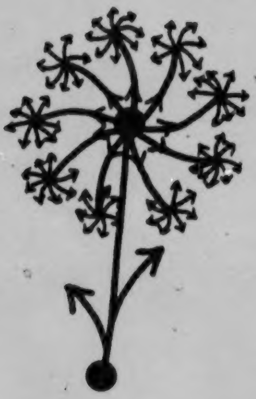
Arrow Flowers.

MATERIALS:

Paper*; charcoal* or colored pens* or crayons*

The object is for the children to draw imaginary flowers made of arrows.



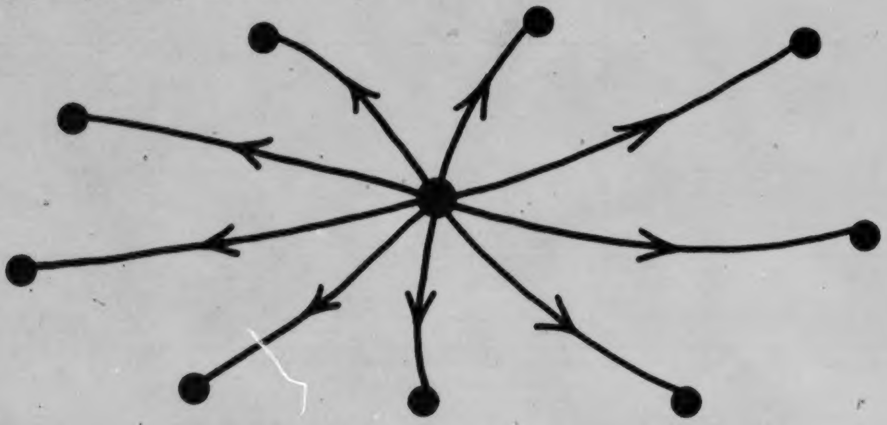


Favorite Places.

MATERIALS:

Paper*; colored pens* or crayons*

Ask the students to draw a dot for themselves approximately in the middle of their sheets of paper. Then, ask them to draw dots all around this dot for places they like to visit. Finally they should draw arrows, each of which indicates, "I like to go to . . ." Some children might want to tell you what places their dots represent. Be prepared to listen! Here is one possible picture among many, many others.



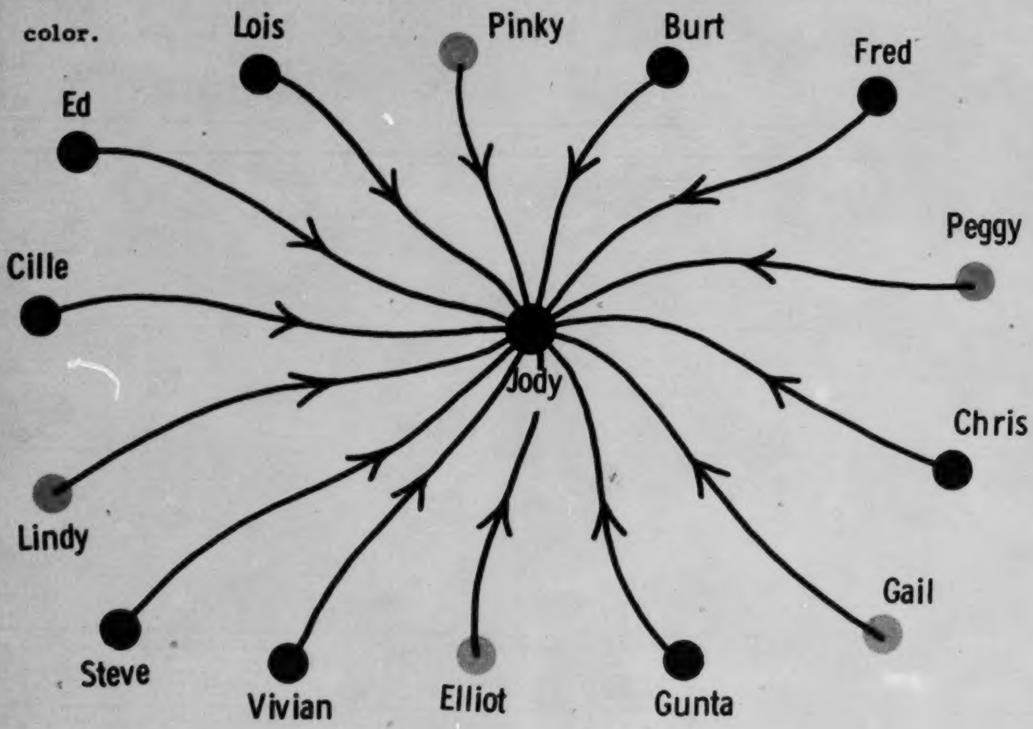
To be consistent with the language of arrows, all the arrows should be drawn in the same color.

The Birthday Poster.

MATERIALS:

A large sheet of paper*; colored magic markers* or crayons* or finger paint*

This could well become a traditional part of every birthday celebration in your classroom. The hero of the day is represented by a big dot in the middle of the sheet of paper. Every child in the room draws a dot for himself or herself, and an arrow meaning "... wishes a happy birthday to ..." Once again, to be consistent with the language, all the arrows should be drawn in the same color.


Lois
Pinky
Burt
Fred
Ed
Peggy
Cille
Jody
Chris
Lindy
Gail
Steve
Vivian
Elliot
Gunta

S3 EXERCISES IN LISTENING

To succeed in school, students have to be able to listen, and to understand what they are listening to. Many students who are perfectly capable of understanding fail to realize their potential simply because they do not take the time to listen. To help your "little dreamers" to learn to concentrate plan "listening activities" such as:

- recordings (music, stories) involving group participation
- songs and games in which lists of ever-increasing length have to be memorized and recited. For example:

  "I know an old lady who swallowed a fly."
  "Old Macdonald had a farm."
  "I went to market, and I bought . . ."

- games such as those described below.

Simon Says.

In this well-known game, the teacher (or the player who is "it") gives directions, which are to be obeyed only if preceded by the words, "Simon says."

Examples: Simon says, Jump! (Everyone should jump.)
Turn to the right! (Nobody should move.)
Sally says, Sit down! (Nobody should move.)

Read My Mind.

The teacher gives clues about objects in the room and the children are to determine what the teacher has in mind. The more clues and the fewer objects that fit the description, the more difficult is the game. For instance:

> I am thinking of something in this room which can be rolled. (Possible answer: piece of chalk, a ball.)
>
> I am thinking of a child who is sitting close to the window, is not a girl, and is wearing sneakers.

Everyone Listens, Everyone Acts.

This game is described in Lesson K18-2.

S4 SMALL GROUP ACTIVITIES

Many teachers have managed to fit into their classroom schedules periods of time when they work with small groups of students, or when the students work in small groups by themselves. The major advantage of such "small group periods" is probably that of being able to address specific needs. For instance, such periods allow you to provide appropriate activities for both your "slower" and your "faster" students.

Many of the activities suggested in the day-by-day section of this guide can easily be adapted for use with smaller groups. In particular, we mention the following lessons.

Counting Activities

K3: Number Readiness #1
Activity A: Counting Songs
K18-1: Orchestra
K44: Number Readiness #5
Ten Children; Last Year, Next Year
K47: Number Readiness #6
Activity B: The 0-99 Numeral Chart
K86: Counting Song: "Ten Green Frogs"

Nonnumerical Activities

K14: Centimeter Rods #3

K17: K - A Blocks #3

Find It; The Hidden Piece

K24: Mirror Symmetry #1

Activity 2: The Mirror Game

K25: K - A Blocks #4 (Guess My Rule)

K37: K - A Blocks #6

Comparison Contest; The Piece in the Box

K38: Centimeter Rods #5 (Designs)

K66: Catch the Tiger #1

K78: Mirror Symmetry #3

K87: Mirror Symmetry #4

Activities with Small Numbers

K3: Number Readiness #1

Activity B: Inside the String

K6: Number Readiness #2

Happy Fish; Number Contest

K9: Ways to Make Six

(or any other small number)

K12: Number Readiness #3

Don't Make a Sound; Rhythm

K21-1: Transforming a Number #1

(use this idea with any small number)

K50: Guess My Number #1

K53: My Number Book

K77: The Jumpy Frogs #1

K83: Number Readiness #11

Movie Theater #1; Two by Two

K95: The Jumpy Frogs #2

K97: Movie Theater #2

K102: Number Readiness #12

Activity A: What Happened?

For the remainder of this section we describe some activities that are specifically intended for use with small groups, generally consisting of from four to six students.

The descriptions of some of the activities are preceded by an indication of their levels of difficulty.

* means the activity is easy

*** means the activity is difficult.

When there is no such indication, then it means that the activity can be adapted to various levels.

A. COUNTING ACTIVITIES

Counting Contest (4 to 6 players)

Each player in turn says a number, beginning at one and counting by ones. A player who makes a mistake or who doesn't follow quickly enough is "out." The winner is the one who remains after everyone else is "out."

Variations:

- Don't start at one.
- Start at one, but count by twos.
- Count backward starting from a specified number.

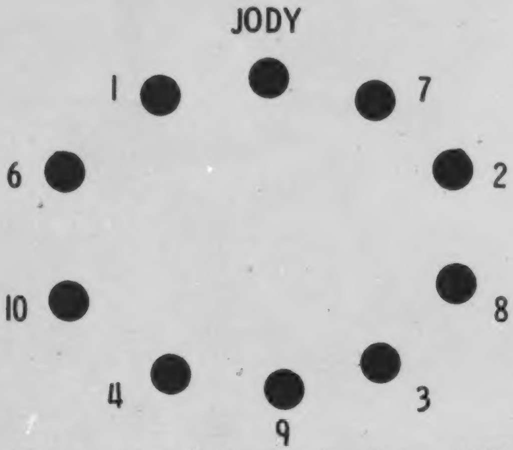
Commercial Board Games

One of the most enjoyable counting activities is the playing of a typical game (found in many toy departments) in which the player moves a checker on a board by counting spaces, the number of spaces of the move generally being indicated by a die or a spinner face. Most classrooms have a supply of such games. These can be played during free time and usually do not need adult supervision. You might suggest that for variation the players count by twos, by threes, and so on, rather than by ones.

*** What's Your Number? (5 to 10 players)

List the numbers from 1 to (at most) 10 on the board. Ask that number of children to stand in a circle. Explain that you are going to pin a card with one of these numbers on everyone's back. No one should be able to see his or her own number, but by walking around the circle each child can see everyone else's number.

When you call on a child, he or she walks around the circle (several times if necessary), looks at all the other numbers, and tries to deduce what number is written on the card on his or her back. For instance, from:



Jody can deduce that her number is 5. Having deduced the number on his or her back, a child should go and stand facing the chalkboard in front of the corresponding numeral. The other students can then check whether or not the child has reasoned correctly. The fewer the players, the easier the game.

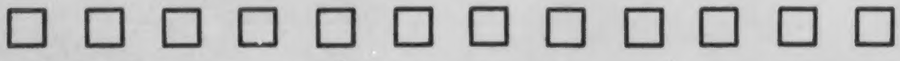
B. ACTIVITIES WITH SMALL NUMBERS

* Designs (any number of participants)

MATERIALS:

Several little squares with sides of different colors[**]

T: Let's count 12 squares, and line them up to make a train. Let's count them together.



You will have some squares with their blue face showing and some with their red face showing.

[**] In what follows we assume that one side of each little square is red and the other blue.

T: Now, make a design using these 12 squares.

Let the children make their designs any way they wish.

Here are two examples:

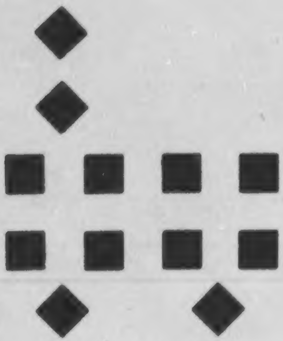


Figure I

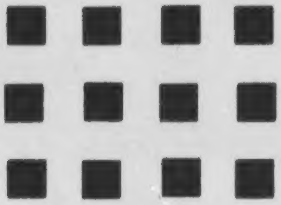


Figure II

Ask the students to describe their designs.

For instance, for Figure I:

S: It is a train engine.

T: Which colors did you use?

S: Two blue squares for the smokestack, eight red ones for the main part of the engine, and two blue ones for the wheels.

For Figure II:

S: They are soldiers marching in columns.

T: How many columns?

S: Four.

T: How many soldiers in each column?

S: Three.

T: Four columns of three ... or three rows of four (trace the rows or columns each time).

How many blue soldiers?

S: Six blue ones, and six red ones.

T: How many altogether?

S: 12.

Before asking the students to make another design with the 12 squares, let them line them up again, as they were at the beginning of the activity.

Jigsaw Puzzles with Numbers

We provide two jigsaw puzzles with numbers, one representing a frog, and one representing a dog. Two copies of each of these puzzles are packaged with the demonstration numeral cards. For each puzzle, you should leave one picture (in which the pieces are identified with numerals) permanently put together. The other picture (in which the pieces are identified with dot patterns) should be cut into pieces. One way of putting the puzzle together consists of determining how many dots are on a given piece, locating the piece in the complete picture which bears the corresponding numeral, and fitting the first piece exactly on top of the second. When a puzzle is completed in this way, the end result will be a complete picture sitting on top of the permanently put-together complete picture.

Between uses each puzzle (picture and pieces) may be stored in a large envelope.

Variations:

- Use the "dot-pieces" to form the permanently put-together complete picture and the "numeral-pieces" as the individual pieces that are used to form a copy of that picture.
- Instead of making a complete picture by placing corresponding pieces on top of each other, construct a copy side-by-side with the permanently put-together complete picture.

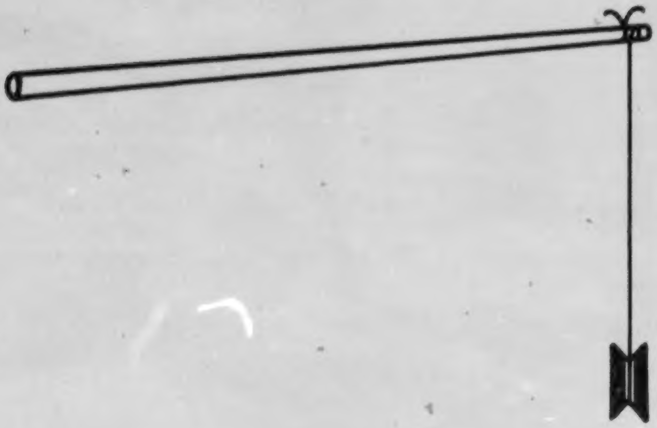
* The Fishing Pool #1 (3 to 6 players)

MATERIALS:

20-25 cards* with a numeral written on each of them, and a paper clip* attached to each card; a magnetic fishing rod* (see Note #1 below)

IMPORTANT NOTES:

1. A magnetic fishing rod can be made out of a ruler, a piece of string and two demonstration Minicomputer checkers glued top to top, magnetic side out. Before you use such a fishing rod, test it to see whether or not your cards are light enough.



2. You may increase the number of cards if you so desire.
3. Several cards may have the same numeral written on them.

DESCRIPTION OF GAME:

Lay the numeral cards on a table or on the floor, numeral side down. The players take turns to "catch" a card with the magnetic fishing rod.

A player who, upon "catching" the first card, can read the numeral written on it is allowed to "catch" a second card. (No more than two cards per player per turn.)

This goes on until all the "fish" have been caught.

The winner is the angler who caught the most "fish" (i. e., cards).

Variation:

- Replace the numerals on the cards by dot pictures.

The Fishing Pool #2 (3 to 6 players)

MATERIALS:

10-20 cards*, each with a numeral written on one side, the corresponding number of dots on the other side and a paper clip* attached to each card; a magnetic fishing rod* (see Note #1 in "The Fishing Pool #1" above)

NOTE:

Several cards may have the same numeral written on them. The first few times you play this game, you should deal only with fairly small numbers (say, in the range 0-6).

DESCRIPTION OF GAME:

Lay the numeral cards on a table or on the floor, numeral side up.

The players take turns to "catch" the "fish." The fishing rod should make two complete circuits of the group of players, and on each turn a player is allowed to "catch" only one card. Thus, at the end, each player has exactly two cards. At this point, each player figures his or her "score" (this can be done by counting the dots that appear on the back sides of the two cards). For instance, a child who "catches" a "6" and a "2" has a score of 8. The player with the largest score wins.

You may want to record everybody's results on the board, for instance

$$6 + 2 = 8$$

$$5 + 1 = 6$$

$$4 + 4 = 8$$

$$6 + 3 = 9$$

Variations:

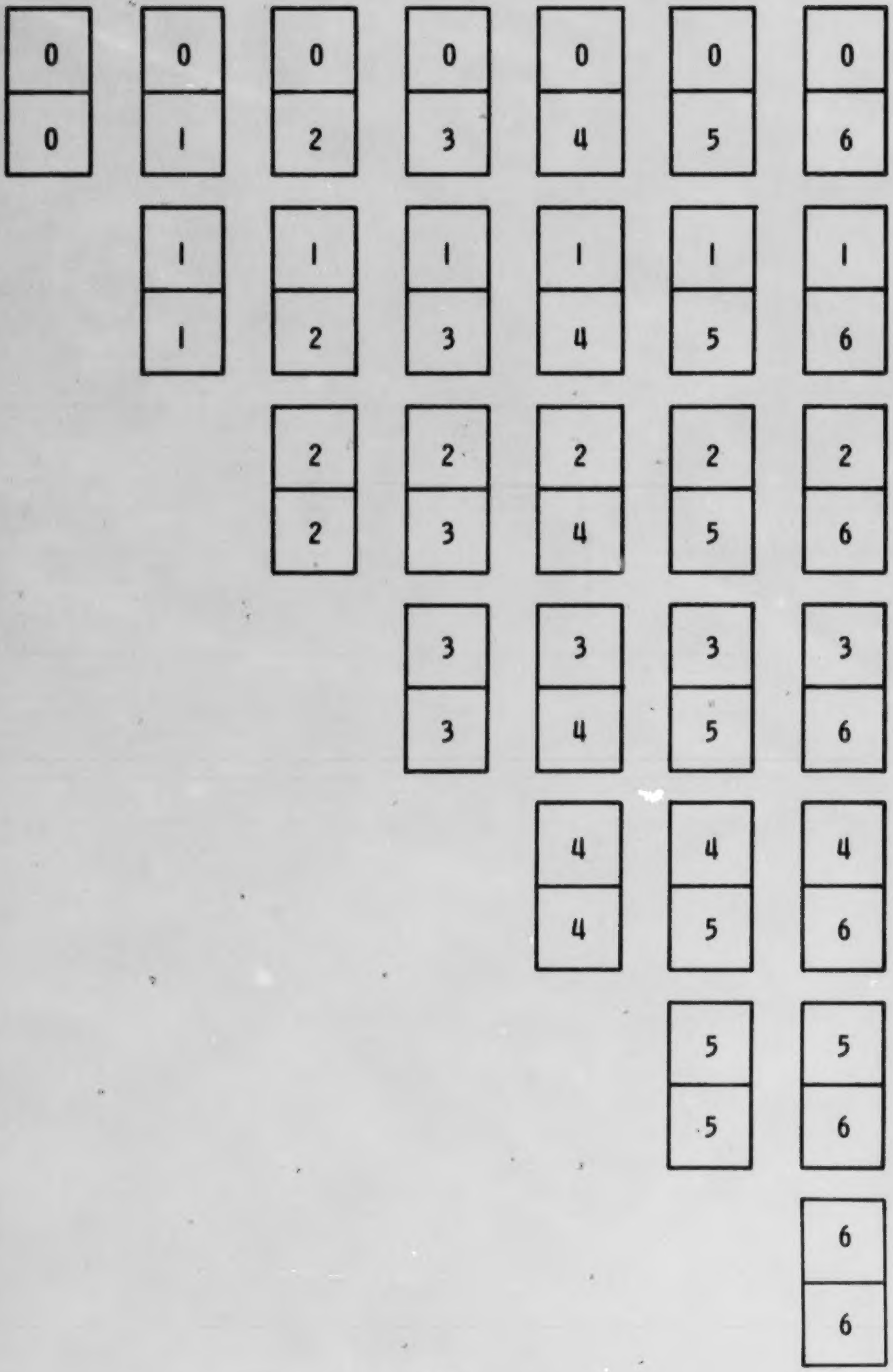
- Allow each child to "catch" a total of three (or even four) cards.
- Use different numerals.

Dominoes (4 to 6 players)

MATERIALS:

A commercially available set of dominoes*; a set of demonstration numeral dominoes* (see below for a description of this set)

Demonstration numeral dominoes can be made out of large pieces of cardboard. Below we reproduce a reduction of a complete set.


0 0
0 1
0 2
0 3
0 4
0 5
0 6
1 1
1 2
1 3
1 4
1 5
1 6
2 2
2 3
2 4
2 5
2 6
3 3
3 4
3 5
3 6
4 4
4 5
4 6
5 5
5 6
6 6

If you cover these demonstration dominoes with transparent contact paper you will be able to use them for many years!

DESCRIPTION OF ACTIVITY:

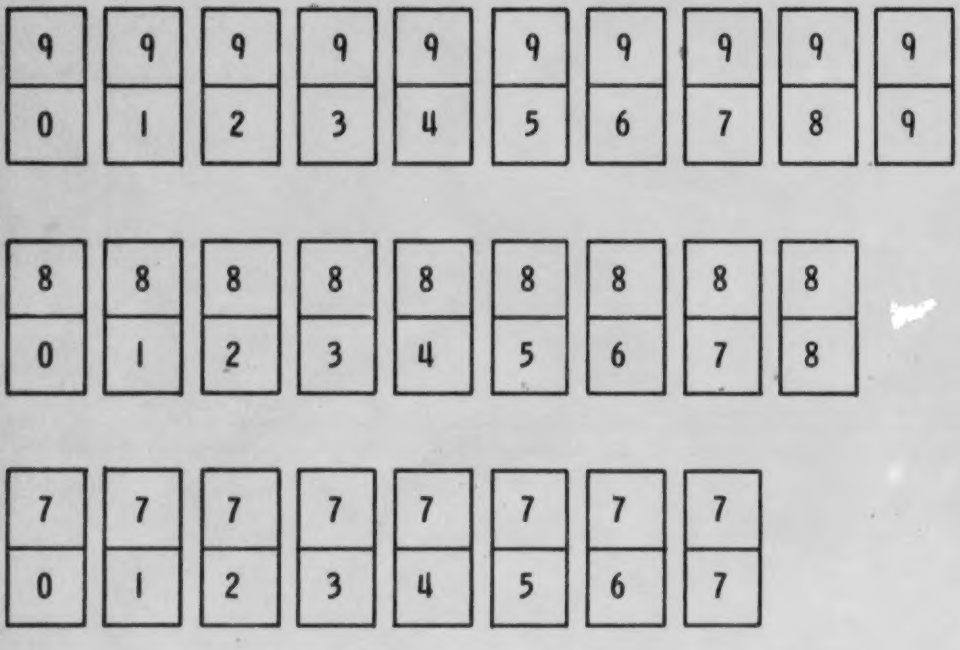
Share the (standard) dominoes among the players in such a way that everyone has the same number of dominoes. (Any extra dominoes should be discarded before you start the activity.)

Choose at random one of your demonstration numeral dominoes, show it to the players, and, if you wish, read it. The player who recognizes that he or she has the corresponding domino may discard it. (If no one claims possession of the domino in question, then the person who actually does have it is stuck with it for the rest of the game.)

The winner is the first one to have discarded all his or her dominoes.

*** Variation:

- The game can be made more challenging if you use a "double-nine" set of dominoes. (Such sets have been in common use in certain Latin American countries for some time, and it is now becoming possible to purchase them in stores in the U.S.) If you use a "double-nine" set of dominoes, you will need to add the following numeral dominoes to your demonstration set:


9 0
9 1
9 2
9 3
9 4
9 5
9 6
9 7
9 8
9 9
8 0
8 1
8 2
8 3
8 4
8 5
8 6
8 7
8 8
7 0
7 1
7 2
7 3
7 4
7 5
7 6
7 7

GENERAL REMARK:

As in the previous section, we note that there is a great variety of commercial games (such as Bingo and darts) which deal with number representations. In addition, you may know of other common games which would be useful in this regard. You should feel free to make use of any and all such activities.

C. THE MINICOMPUTER

The Minicomputer seems to be particularly suitable for use with small groups. Many Kindergarten children are fascinated and challenged by this new game, and they sometimes become very frustrated during the full group lessons,

because they aren't getting enough of it.*

You could allow such children to pursue their exploration in smaller groups. Suggest that they engage in activities similar to those described in the introductory Minicomputer lessons (K80, 92, 99, 106).

Your children might also enjoy the storybook TWO BY TWO,** although some parts of the story are probably too difficult for most of your students. As a result, you should read the story in a very casual way; you are not trying to teach every fact that is mentioned in the story. You should view it as merely giving the children a fresh introduction to the Minicomputer in the relaxed atmosphere of Story Time.

D. NONNUMERICAL LANGUAGES

Small groups of children would enjoy it if you read again any of the storybooks that are the subject of lessons described in the day-by-day guide. The titles of these books are as follows:

81 ROSES
THE PLAYFUL NUMBERS
THE BABY IS BORN

---

* This is not an argument for the removal of the full group lessons on Minicomputer. These are important in order to introduce the tool, and to give the "slower" students a chance to learn from the "faster" ones.

** Two copies of this storybook are provided with the CSMP Kindergarten Teacher's Materials.

We mention again that narration tapes[**] are available so that individuals or small groups of children can enjoy these stories without your having to be there to read to them. (Of course, since THE PLAYFUL NUMBERS has no text, there is no tape for it.)

E. GEOMETRICAL ACTIVITIES

Exploration and Free Play

Several lessons in the day-by-day guide involve free play and exploration with various materials. Among such lessons are the following:

K5:	Centimeter Rods #2 (Free Play)
K8:	K - A Blocks #1 (Free Play)
K30:	Solids #1
K78:	Mirror Symmetry #3
K87:	Mirror Symmetry #4

These lessons are very suitable for re-use with small groups.

One Side-Two Sides

The following activities are only to be used after you have taught

K69: One Side-Two Sides #3

[**] These tapes can be obtained by sending one blank 30-minute cassette tape to CEMREL-CSMP for each story you wish to have recorded. The recorded tapes will be returned to you free of charge. Please be sure to indicate which story you wish to be recorded and to include a stamped, self-addressed envelope.

MATERIALS:

For this activity you will need to collect together or make several objects that have either one side or two sides. The number of such objects you can find is limited only by your imagination! The drawings on the following pages should give you some ideas. All the objects pictured here may be constructed from

cylindrical bands[*]

Moebius bands[*] (a band with a single twist in it)

and some very common objects by gluing them together in various ways.

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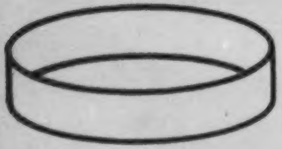
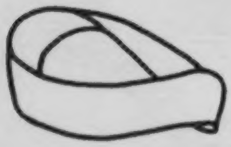
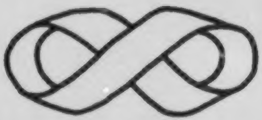
[*] For details about how to make these, see Lesson K60: One Side-Two Sides #2.



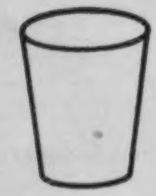
A cylindrical band (2)



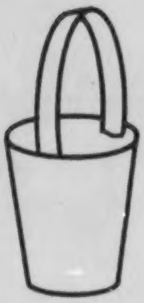
A Moebius band (1)
(one twist)



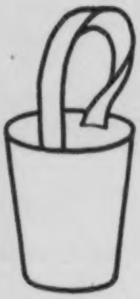
A band (2)
(two twists)



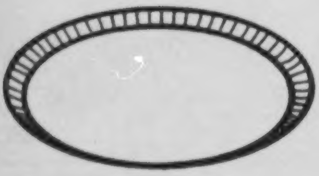
A paper cup (2)



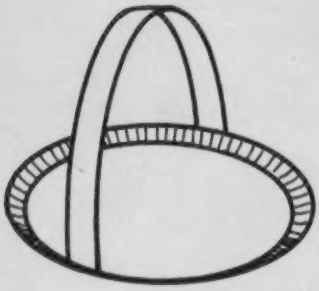
A paper cup (2) with
a cylindrical bridge



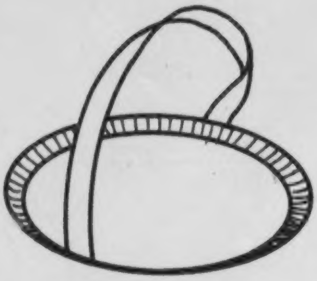
A paper cup (1) with
a Moebius bridge



A paper plate (2)



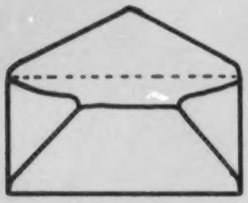
A paper plate (2) with
a cylindrical bridge



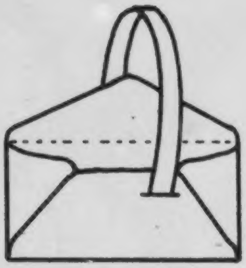
A paper plate (1) with
a Moebius bridge

---

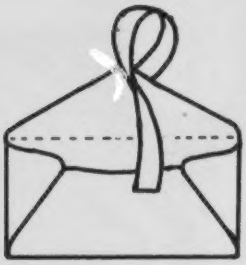
[*] The numerals indicate the number of sides. As a general rule, when you add a Moebius "bridge" to an object having more than one side you will thereby reduce the number of sides by one.



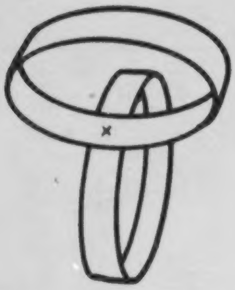
Envelope (2)



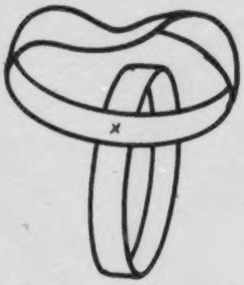
Envelope with cylindrical bridge (2)



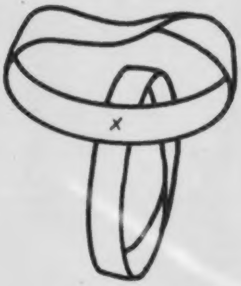
Envelope with Moebius bridge (1)



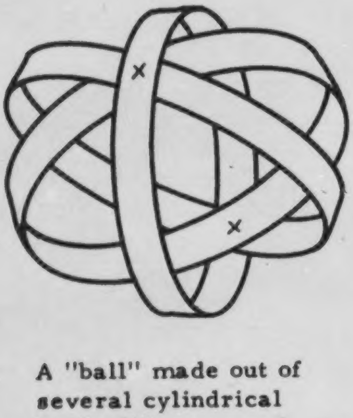
Two cylindrical bands glued together at right angles to each other (2)



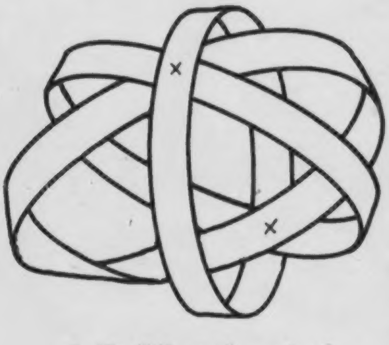
One cylindrical band and one Moebius band glued together at right angles to each other (1)



Two Moebius bands glued together at right angles to each other (1)

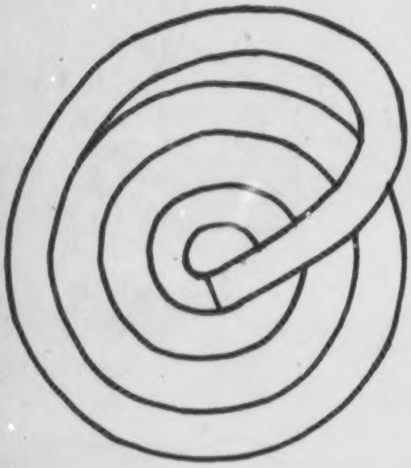


A "ball" made out of several cylindrical bands (2)

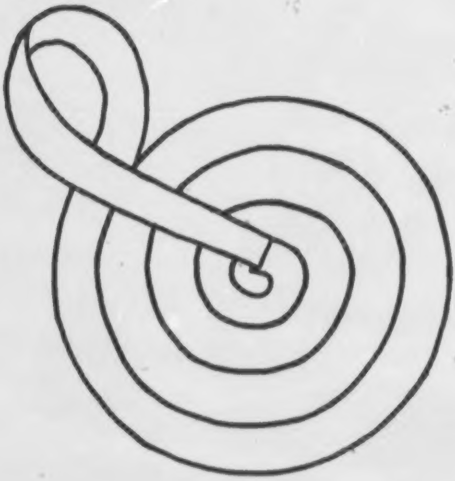


A "ball" made out of several cylindrical bands and one Moebius band (1)

Tape on the "X" .



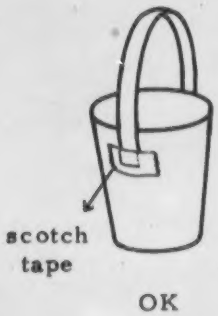
A cut out spiral with its ends glued together (2)



A cut out spiral to which you have given one twist before gluing its ends together

IMPORTANT NOTE:

In the construction of these objects, always use glue or tape, never staples. And when you glue (or tape) two pieces together, be sure that the two pieces are flat up against each other.



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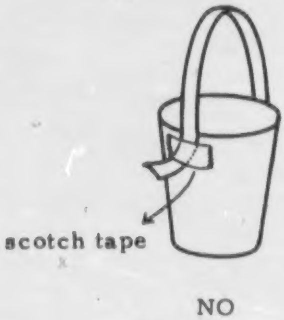

NO

The "bug" could get caught underneath the edge.

DESCRIPTION OF ACTIVITIES:

Show your students a cylindrical band and a Moebius band. Let them tell you what they remember about these two objects. They will probably mention the bugs.

Remind them that

- the two bugs lived "back to back"
- neither of the bugs could cross an edge.

If necessary, let a child check once more that on the Moebius band the bugs can visit each other, while they cannot do so on the cylindrical band.

Display the various objects you have prepared (in the words of some students we worked with, you could call these "constructions in Bugland").

Activity 1:

Give each member of the group a "Bugland construction" and two pencils (of two different colors). Then ask each child to find out whether his or her object has one or two sides (that is, whether two bugs living back to back can visit one another or not).

Repeat this activity with several other "Bugland constructions."

Encourage the children to make predictions before they investigate more carefully whether their objects have one side or two sides.

Variation:

- Ask each child to choose one of your models on which he or she thinks the back-to-back bugs can (or cannot) visit each other. Then let them check to see if they chose correctly.

At the end of this activity your students will have sorted out the "Bugland constructions" into two sets: one made up of all of the objects with two sides, the other made up of all of the objects with one side. Keep these two sets separated until this group of students does Activity 2.

Activity 2: (To be done only with students who have already done Activity 1.)

The students will need paper or light cardboard (some of it pre-cut into strips), scissors, and scotch tape.

Remind the students about your "Bugland constructions" and how they recently sorted them into one-sided and two-sided constructions.

Then ask them to make their own "Bugland constructions," some of them having one side, and some of them having two sides.

CSMP Mathematics for Kindergarten

[illegible] School Mathematics Program
CEMREL, Inc.

Final Experimental Version
[illegible]

Worksheets

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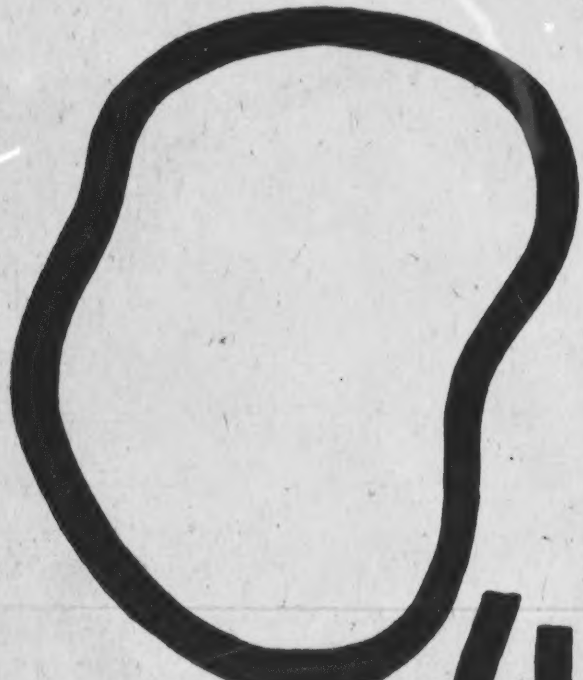
K15 – I *

Name ____________________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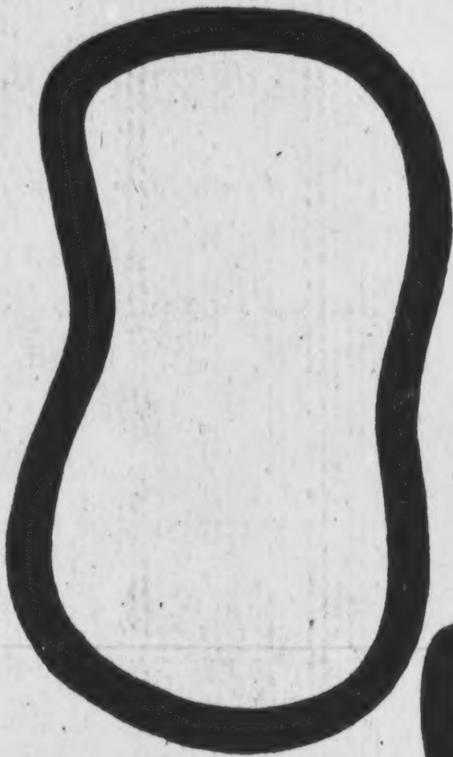
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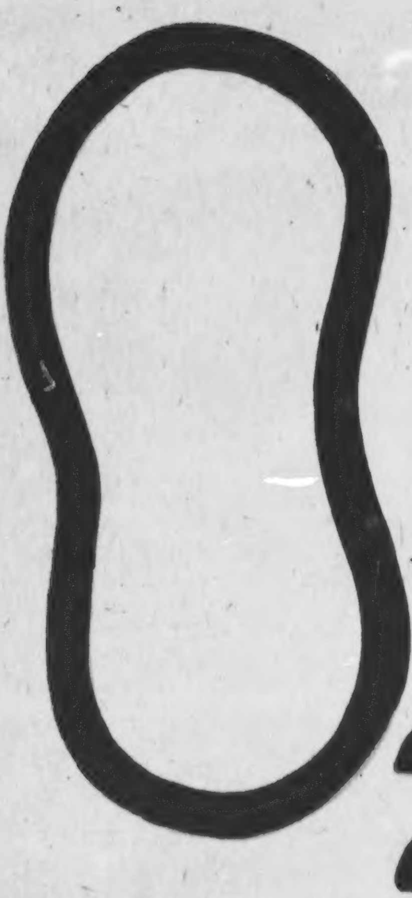
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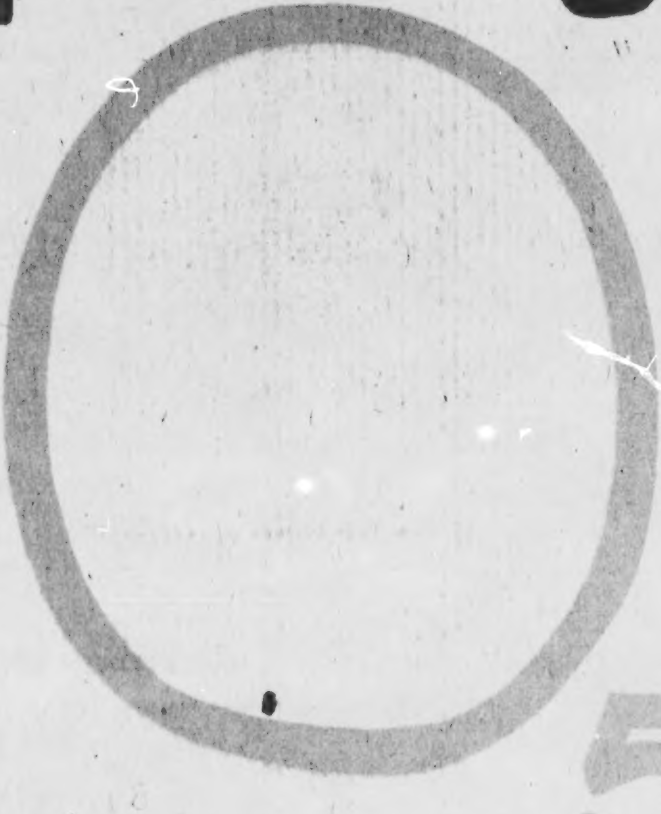
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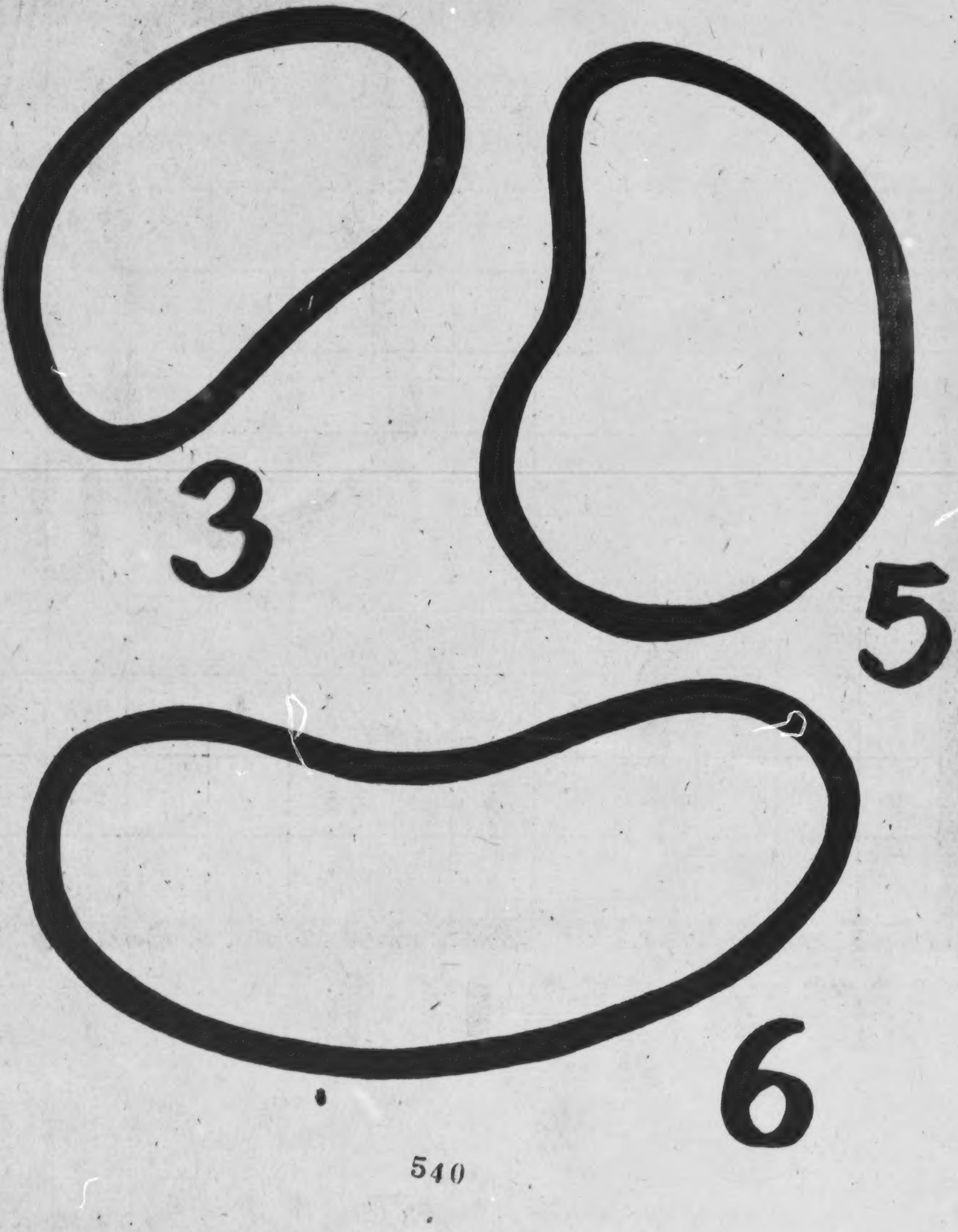
Name ________________________

K15 – II *



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K36 - I *

Name ________________________________

5	5	5	5	5	5	5	5	5	7	5	5
5	5	5	5	5	5	5	5	5	7	7	7
5	5	5	5	5	5	5	5	5	7	7 ●	7
5	5	5	7	5	5	5	5	5	7	7	7
5	5	5	7	7	7	7	7	7	5	5	5
5	5	5	7	7	7	7	7	7	5	5	5
5	5	5	7	7	7	7	7	7	5	5	5
5	5	5	7	7	7	7	7	7	5	5	5
5	5	5	7	5	5	5	5	7	5	5	5
5	5	5	7	5	5	5	5	7	5	5	5
5	5	5	5	5	5	5	5	5	5	5	5

WHAT IS IT ?

COLOR: 5 - GREEN
7 - BROWN

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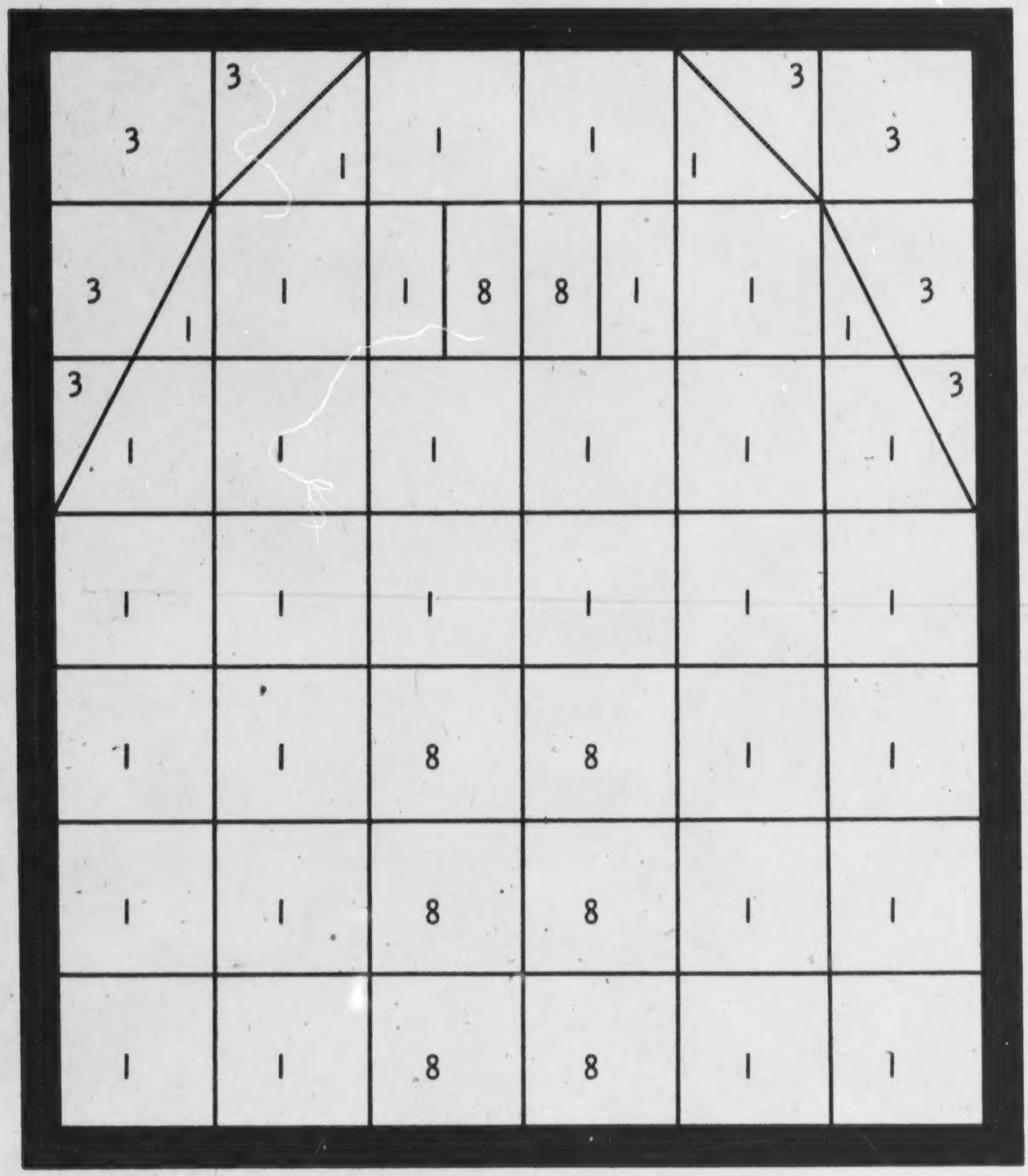
Name ______________________________

K36 – II *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WHAT IS IT ?

COLOR:
1 - RED
3 - BLUE
8 - BLACK

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Name ______________________________

K36 – III **

2	2	2	2	2	2	2	2	2	2	2
2	2	2	2	2	5	2	2	2	2	2
2	2	2	2	2	5	2	2	2	2	2
2	2 4	4	4	4	4	4	4	4	2 4	2
2	4	4	8	4	4	4	8	4	4	2
2	4	4	4	4	8	4	4	4	4	2
2	4	4	4	4	4	4	4	4	4	2
2	4	4	4	8	8	8	4	4	4	2
2	4 2	4	4	4	4	4	4	4	4 2	2
2	2	2	2	2	2	2	2	2	2	2

WHAT IS IT ?

COLOR:
2 - YELLOW
4 - ORANGE
5 - GREEN
8 - BLACK

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K36 – IV ***

Name ______________________________

WHAT IS IT ?

5	5	5	5	5	5	5	5	5	5	7	7	5
5	5	5	5	5	5	5	5	5	7	7	5	5
5	5	5	5	5	5	5	5	7	7	5	5	5
5	5	5	5	5	5	5	7	7	5	5	5	5
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5	5	5	5	5	7	7	5	5	5	5	5	5
5	5	7	7	7	7	7	7	5	5	5	5	5

COLOR:

5 - GREEN
7 - BROWN
9 - WHITE

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K36 – V ***

Name ____________________

6	6	8	8	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
6	8	8	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
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6	6	6	6	6	6	6	6	6	6	6	6	8	8	8	6	6	6	6	6	8	8	8	6

WHAT IS IT ?

COLOR:
6 - PURPLE
7 - BROWN
8 - BLACK

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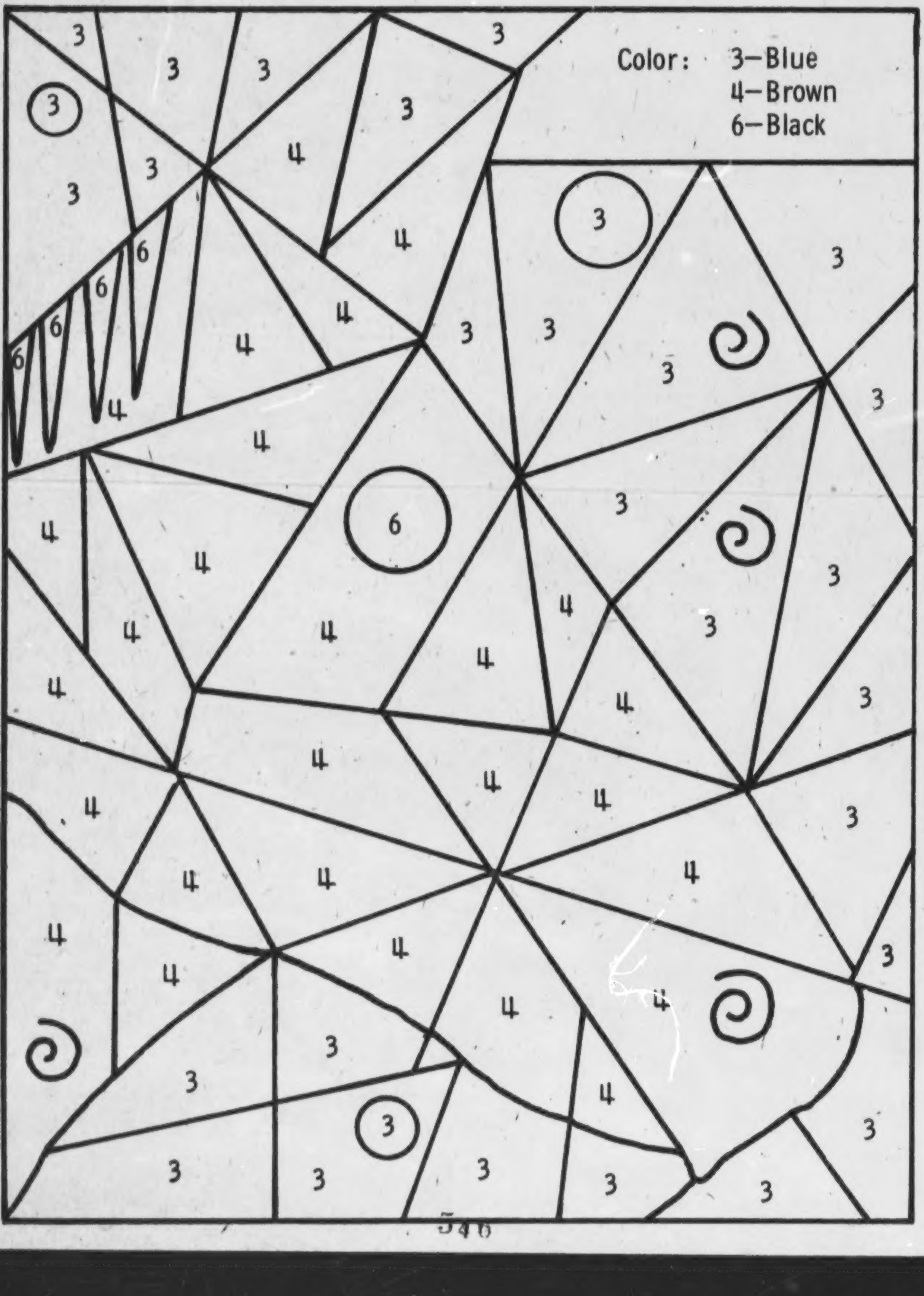
Name ______________________________

K59 – I *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Color: 3–Blue
4–Brown
6–Black

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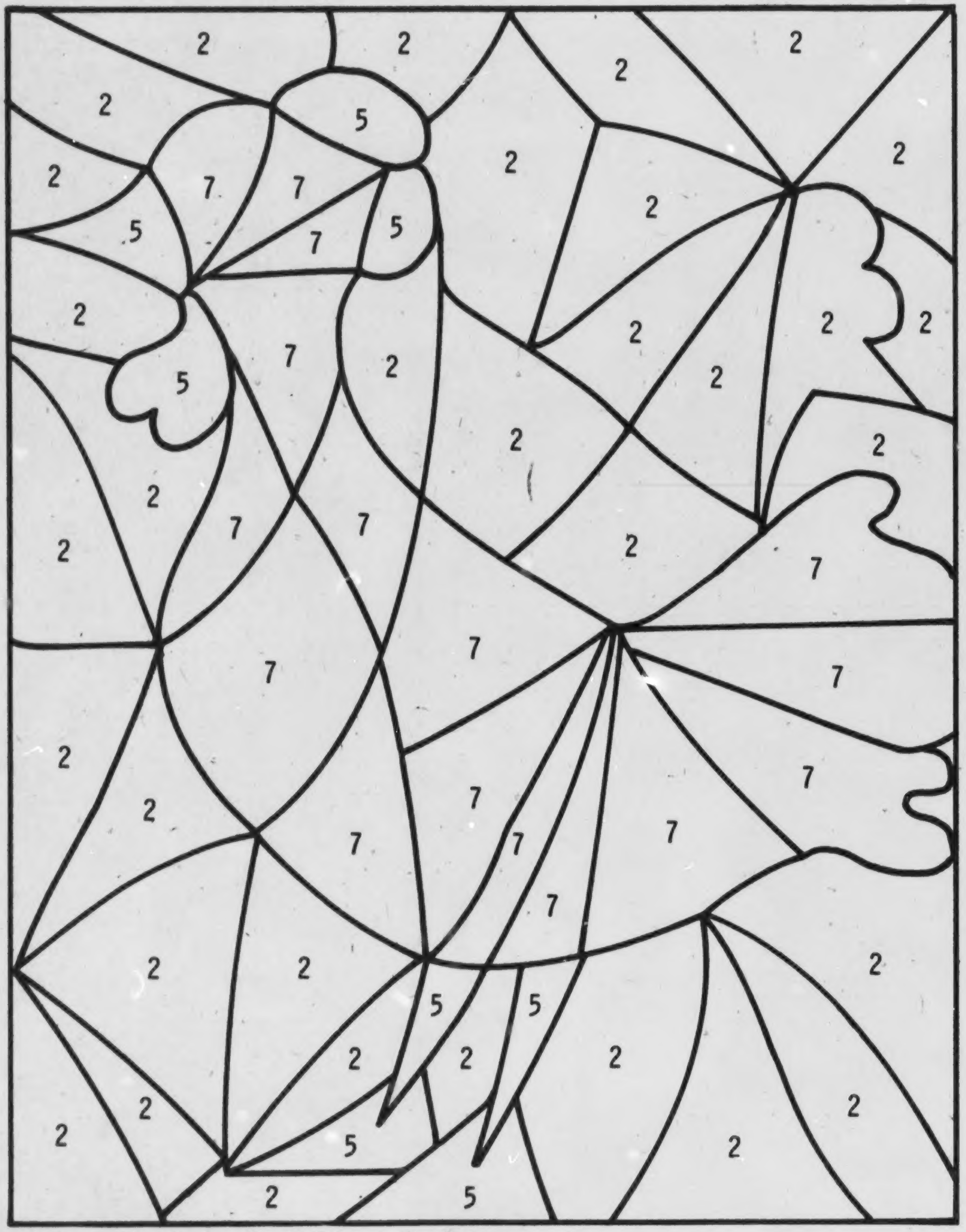
Name ______________________

K59 – II **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Color: 5–Red 7–Yellow 2–Green

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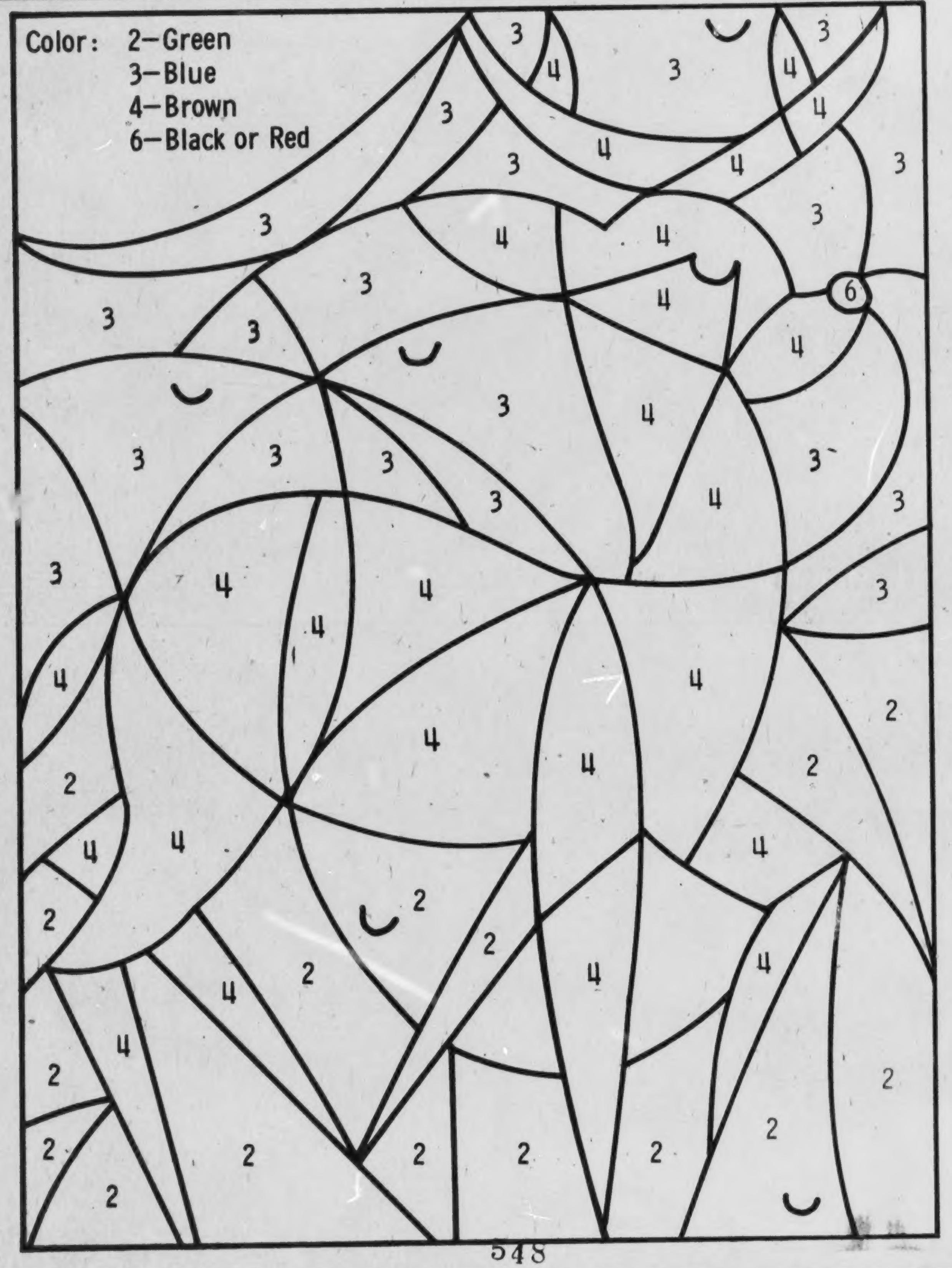
K59–III ***

Name ____________________________________



Color: 2–Green
3–Blue
4–Brown
6–Black or Red

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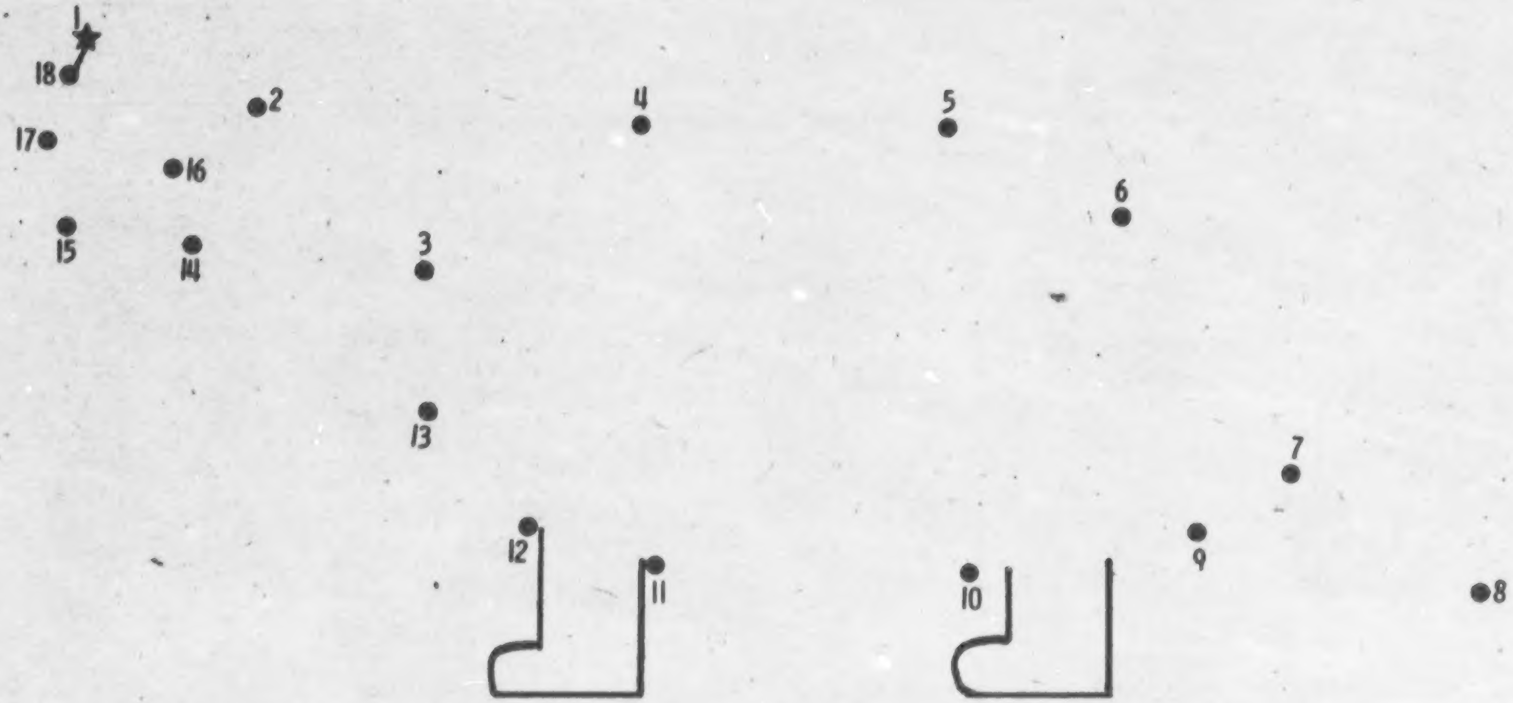
Name ______________________________

K 62–I *

Start at the star. Join the dots, counting by ones.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18
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5
17
16
6
15
14
3
13
7
12
11
10
9
8

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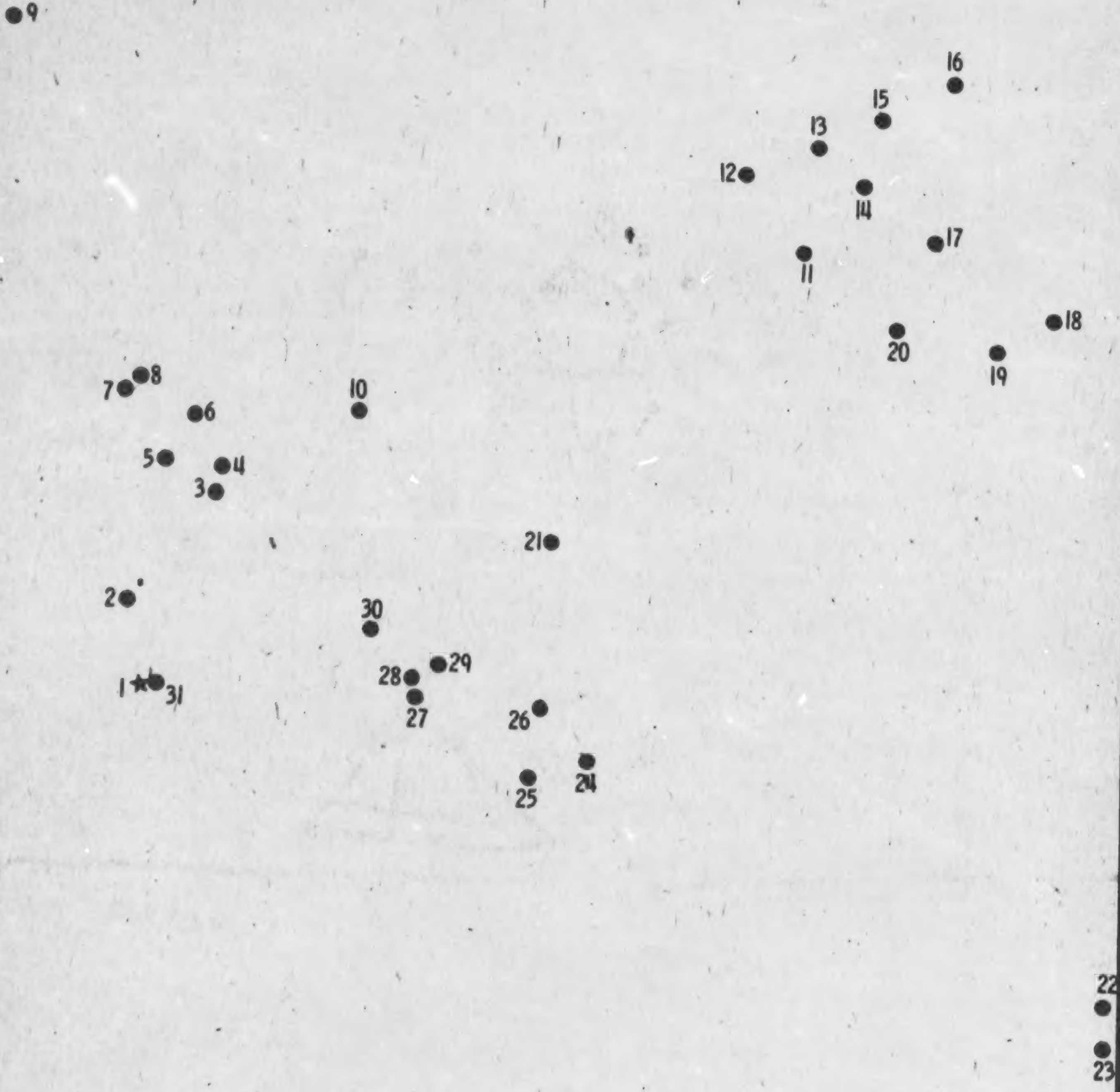
K62-II **

Name ______________________________


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31

Start at the star. Join the dots, counting by ones.

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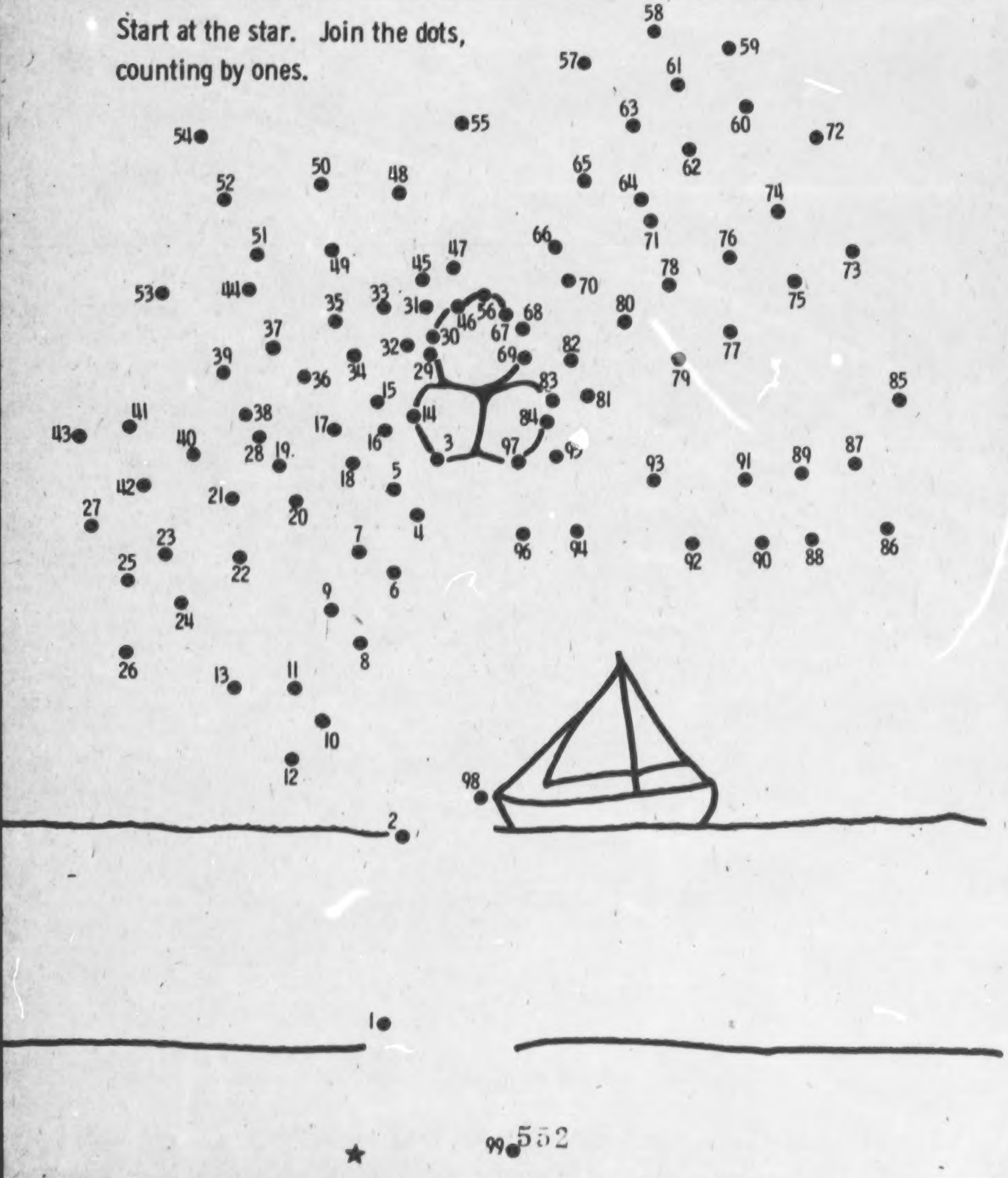
K 62-III ***

Name ________________________________

Start at the star. Join the dots, counting by ones.



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Name ____________________

K 62–IV *

3
4
22
21
20
5
6
19
8
14
13
18
12
17
11
7
16
15
10
9

Start at the star. Join the dots, counting by ones.

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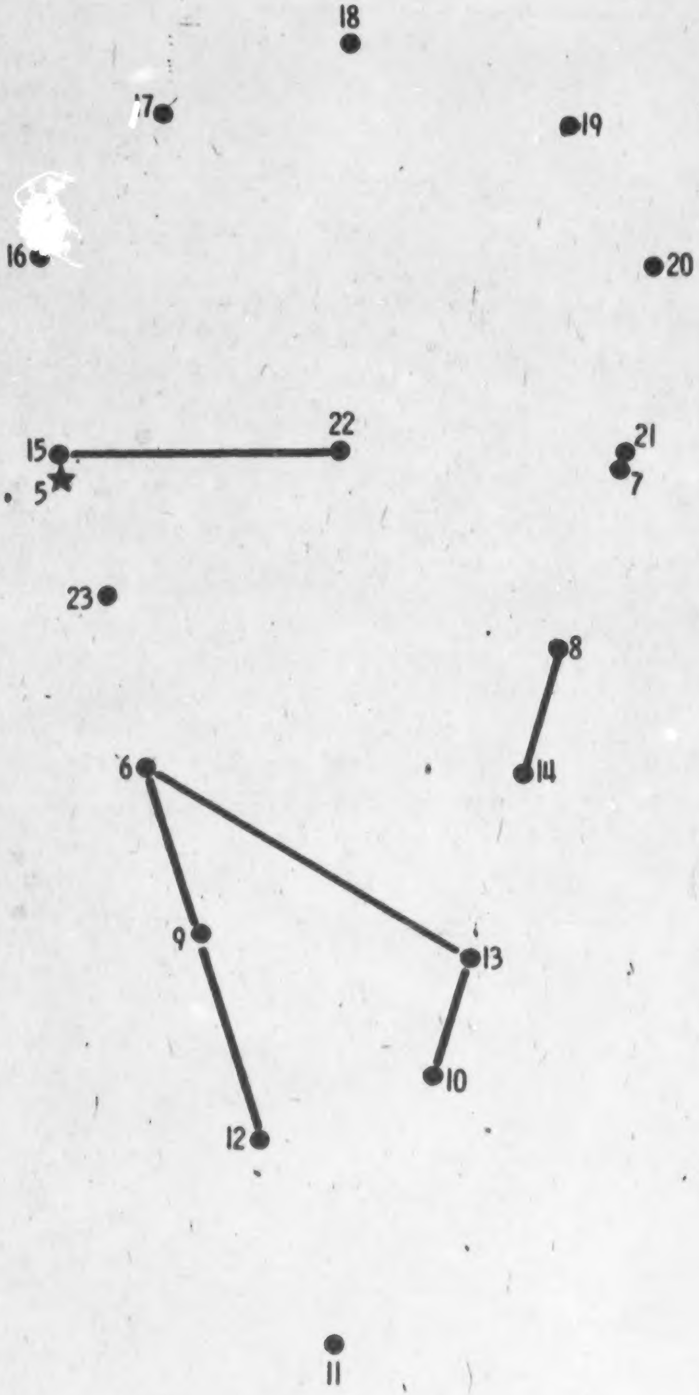
K62–V **

Name ____________________

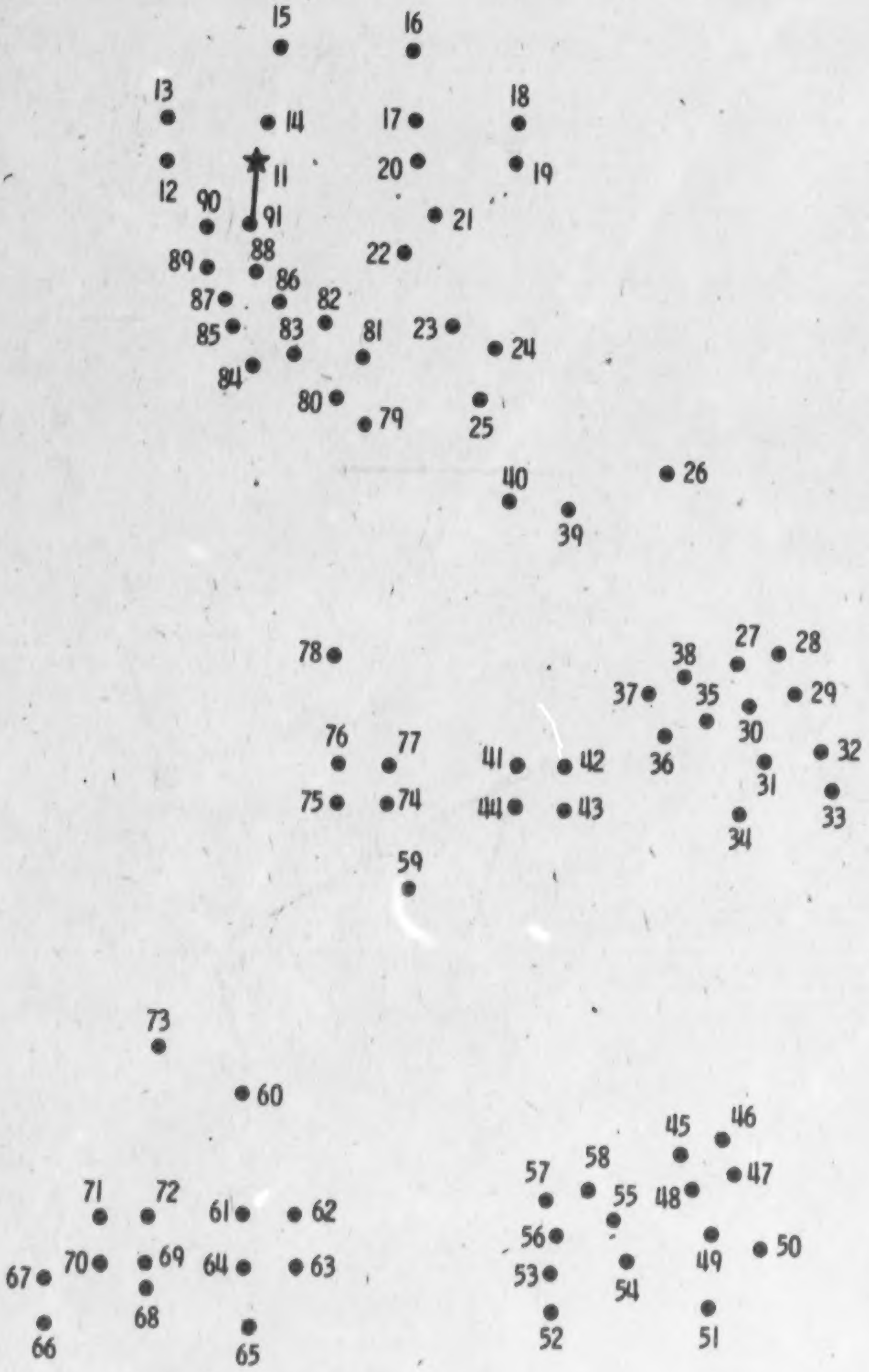

18
17
19
16
20
22
15
21
5
7
23
8
6
14
9
13
10
12
11

Start at the star. Join the dots, counting by ones.

Name ______________________________

K 62-VI ***

Start at the star. Join the dots, counting by ones.


15
16
13
18
14
17
20
19
11
12
90
91
21
89
88
22
86
87
82
85
83
81
23
24
84
80
79
25
40
26
39
27
28
78
38
37
35
29
30
76
77
41
42
36
32
31
75
74
44
43
33
34
59
73
60
45
46
58
57
47
71
72
61
62
55
48
56
70
69
64
63
50
49
67
53
54
68
66
65
52
51

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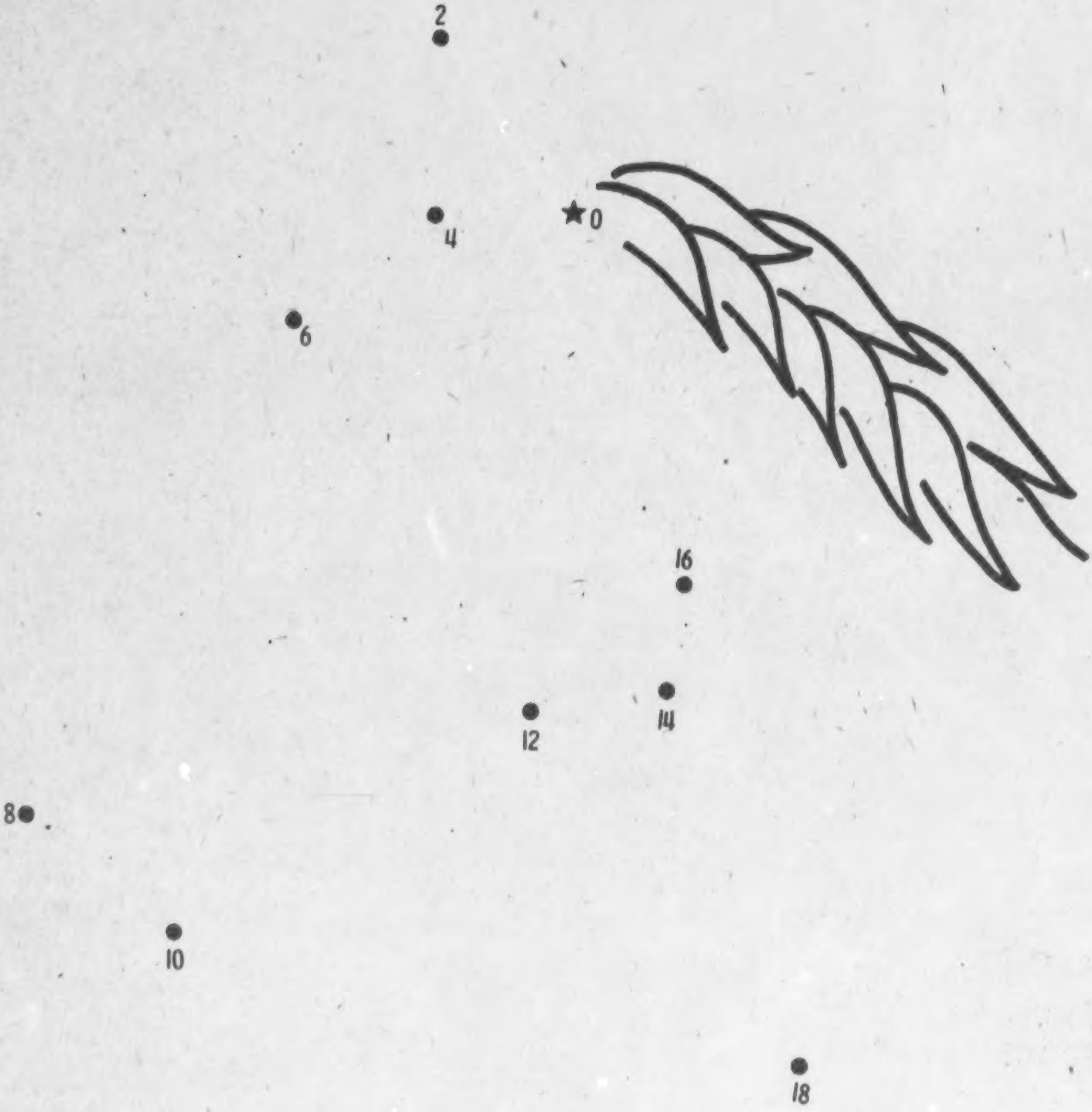
Name ______________________

K62-VII *

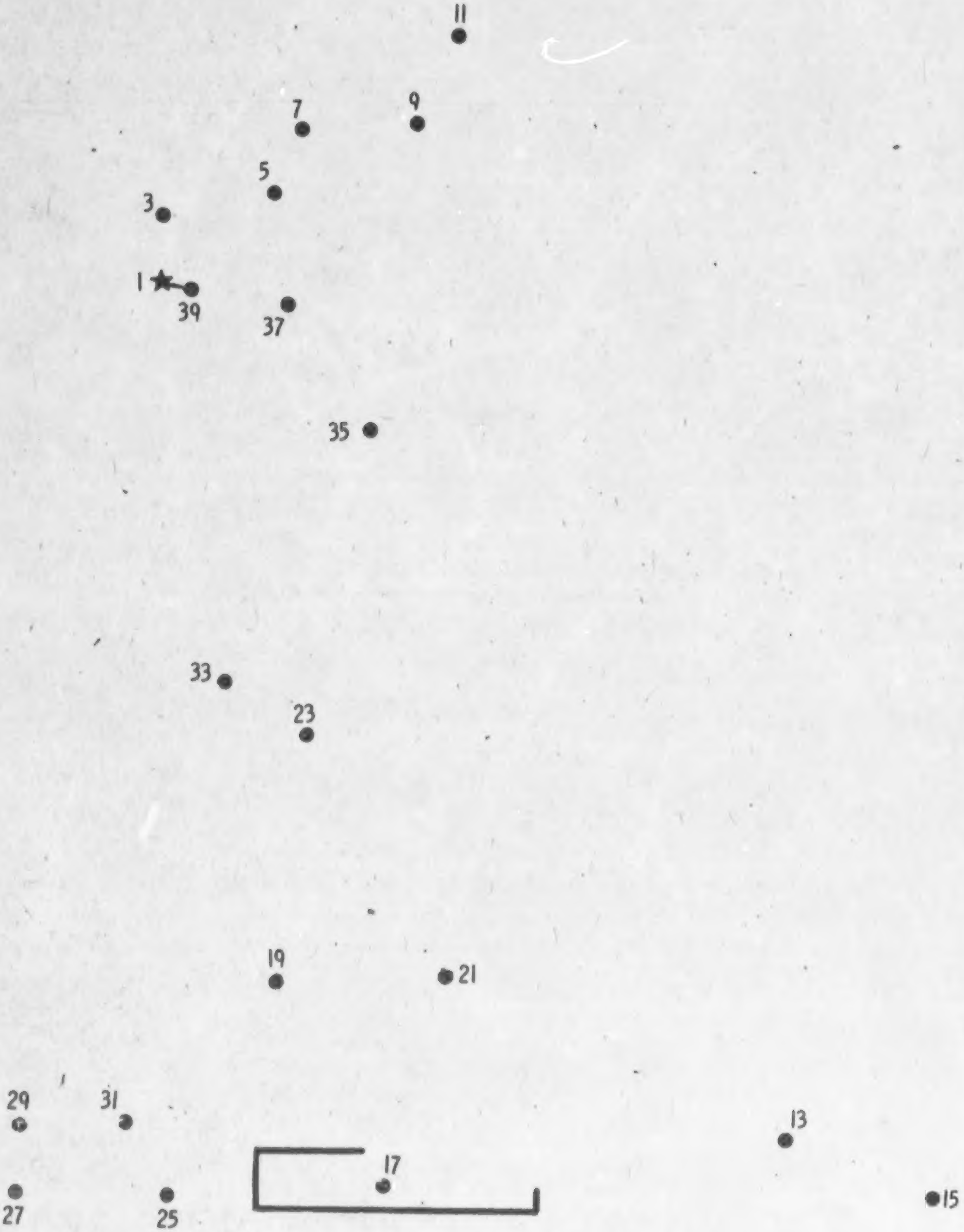
Start at the star. Join the dots, counting by twos.


2
4
★0
6
16
14
12
8
10
18

Name ______________________

K 6 2-VIII **

Start at the star. Join the dots, counting by twos.


11
9
7
5
3
1
39
37
35
33
23
19
21
29
31
13
17
27
25
15

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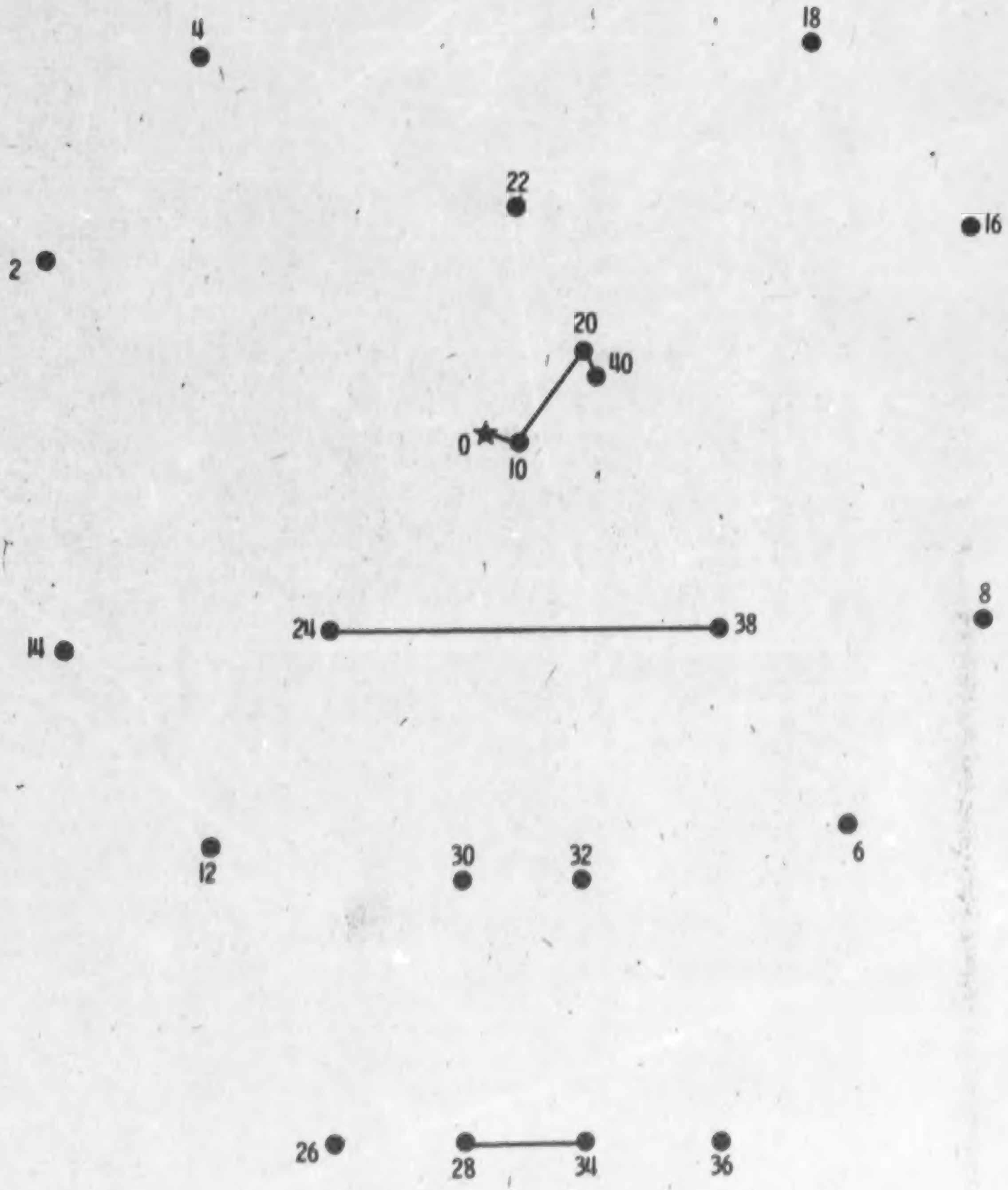
Name ________________________________

K62-IX ***


4
18
22
16
2
20
40
0
10
8
24
38
14
6
12
30
32
26
28
34
36

Start at the star. Join the dots, counting by twos.

Name ______________________

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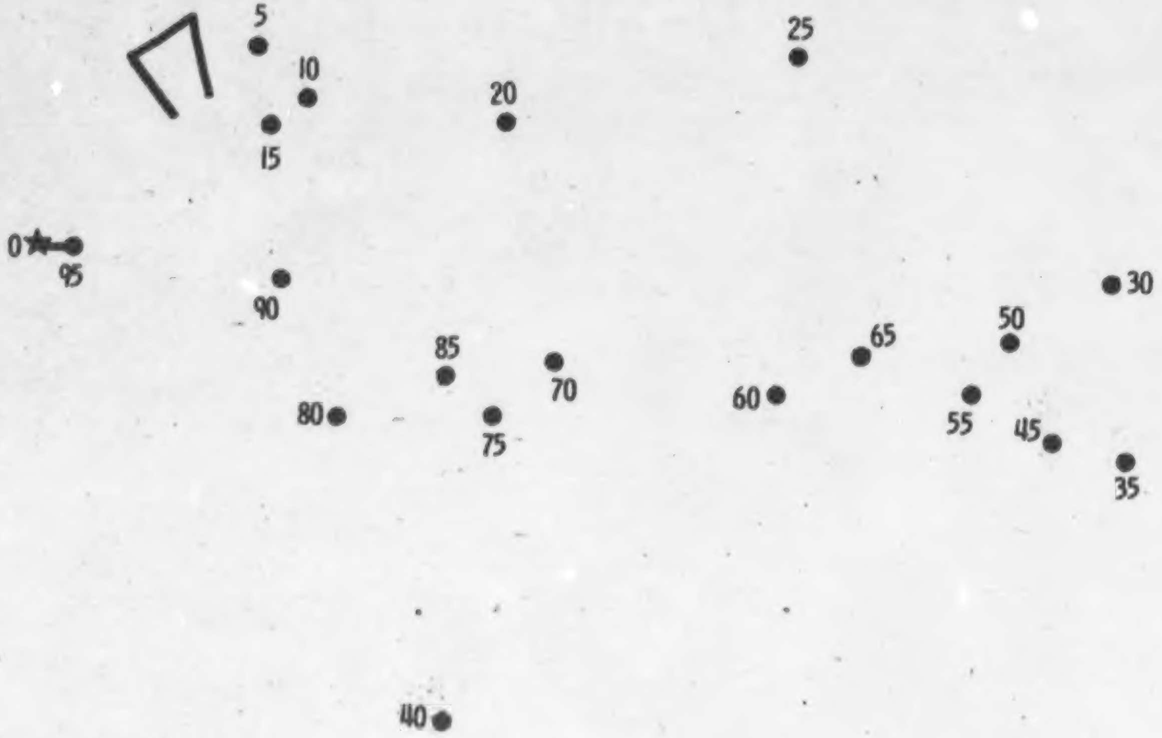
K62-X-***

Start at the star. Join the dots, counting by fives.


5
25
10
20
15
0
95
90
30
50
65
85
70
60
80
75
55
45
35
40

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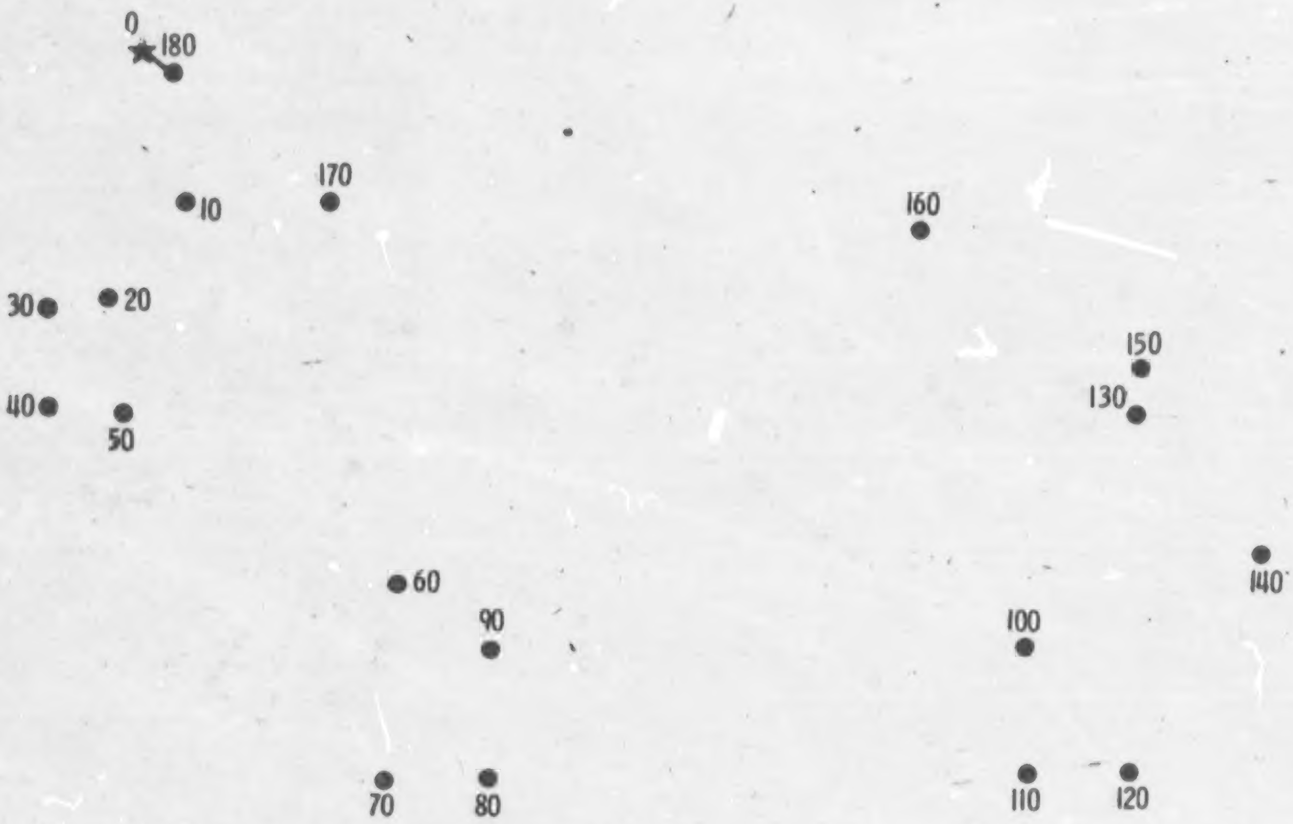
K62–XI ***

Name ____________________________________

Start at the star. Join the dots, counting by tens.


0
180
10
170
160
30
20
150
130
40
50
140
60
90
100
70
80
110
120

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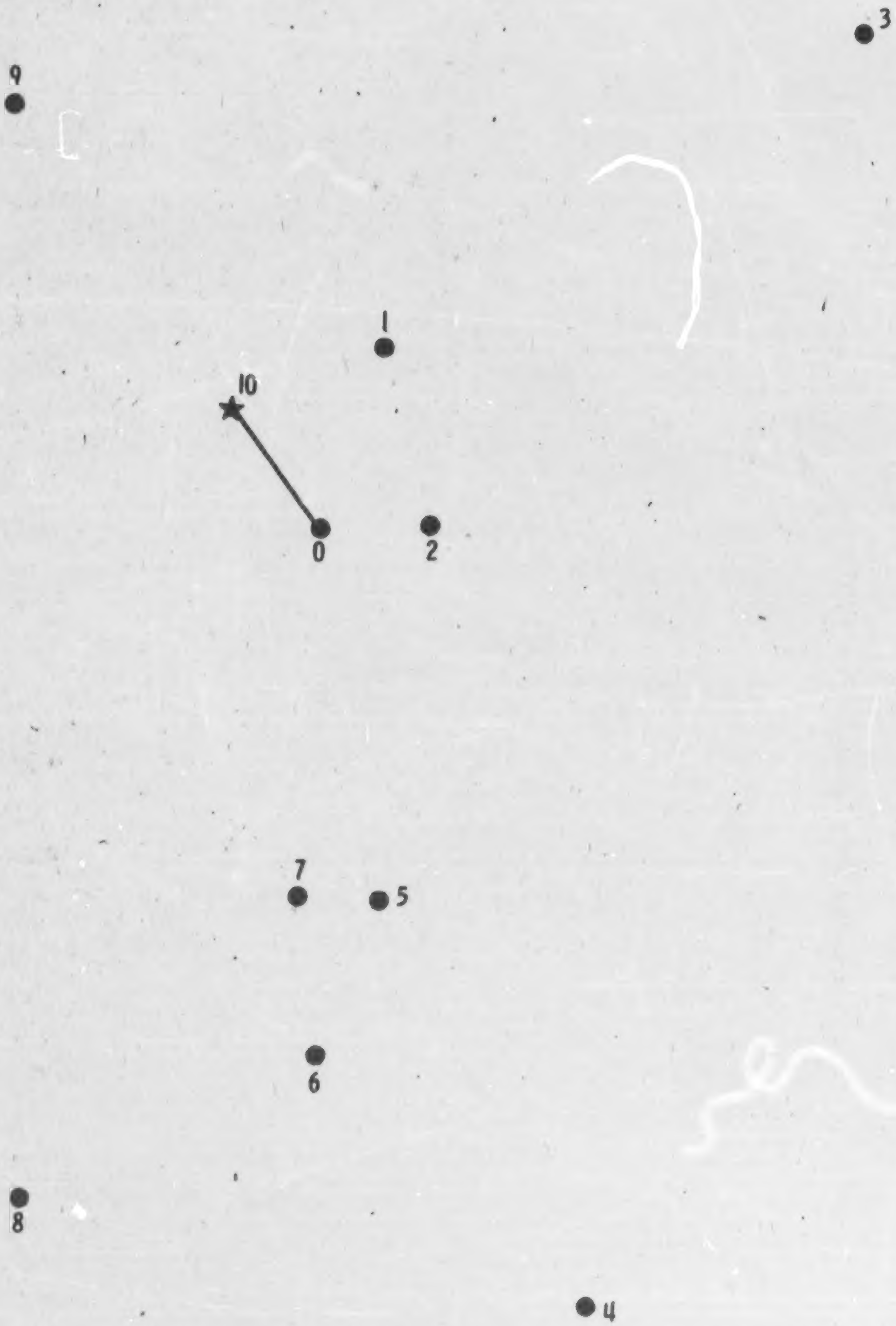
K62-XII*

Name ______________________________

Start at the star. Join the dots, counting backward.


3
9
1
10
0
2
7
5
6
8
4

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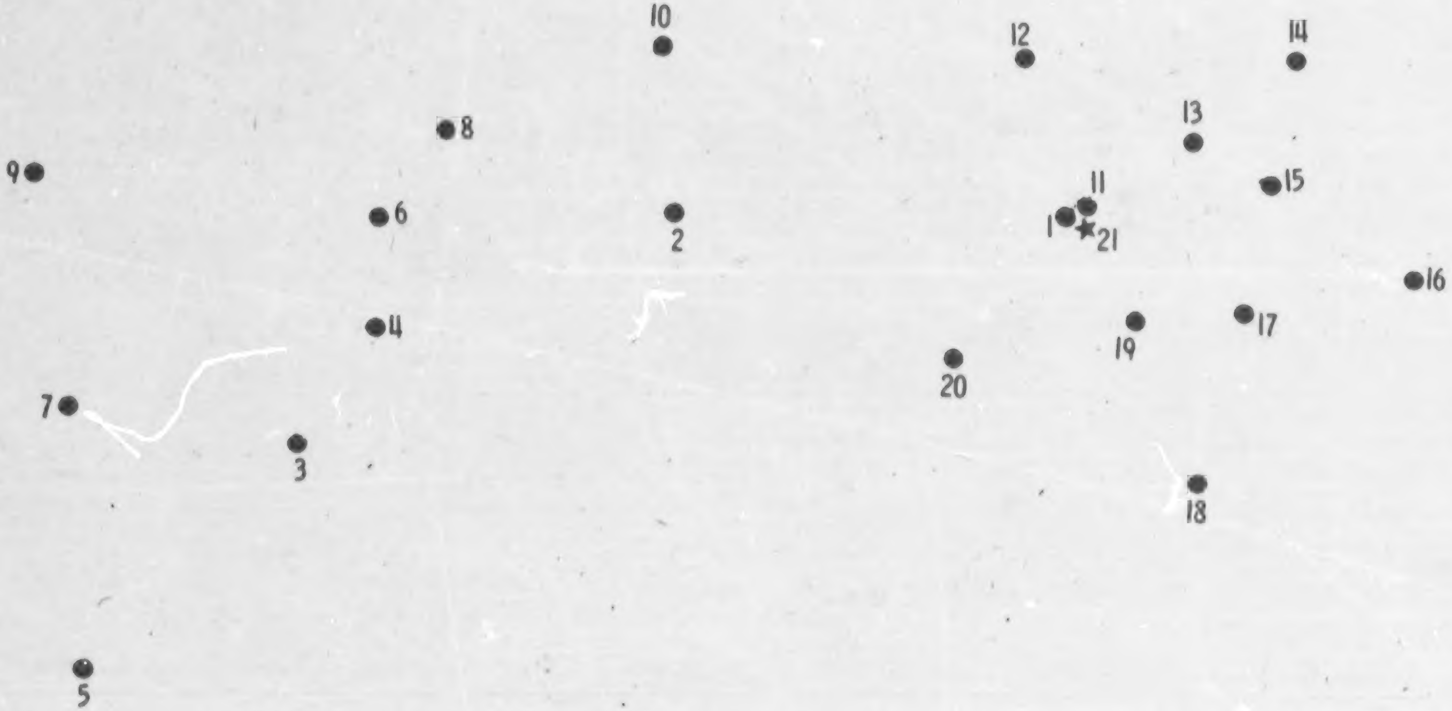
K62–XIII**

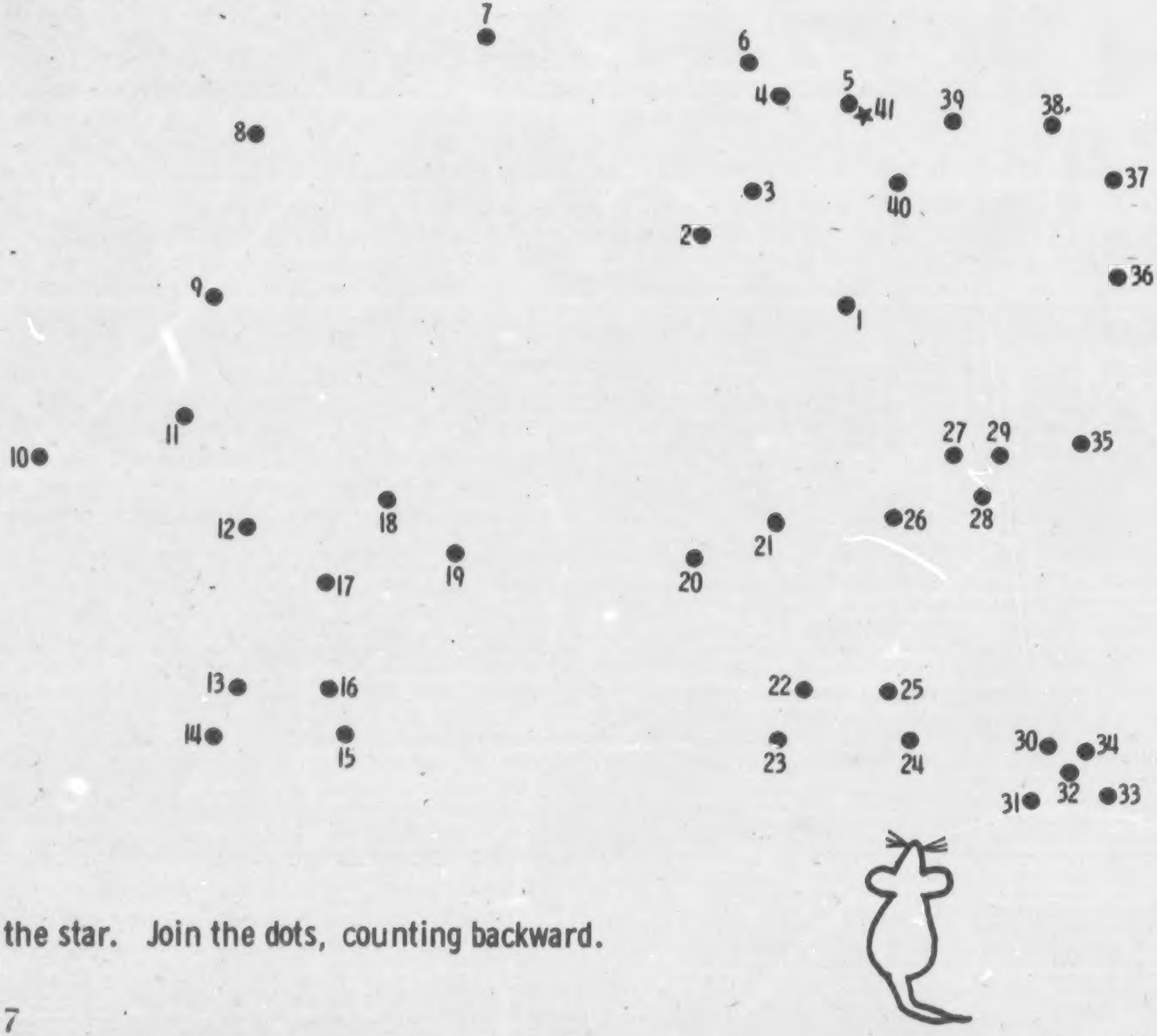
Name ______________________________

Start at the star. Join the dots, counting backward.


10
12
14
8
13
9
11
15
6
2
1
21
16
4
17
19
20
7
3
18
5

Name ______________________

K62-XIV***


7
6
4
5
41
39
38
8
3
40
37
2
36
9
1
11
10
27
29
35
18
26
28
12
21
19
20
17
13
16
22
25
14
15
23
24
30
34
32
31
33

Start at the star. Join the dots, counting backward.

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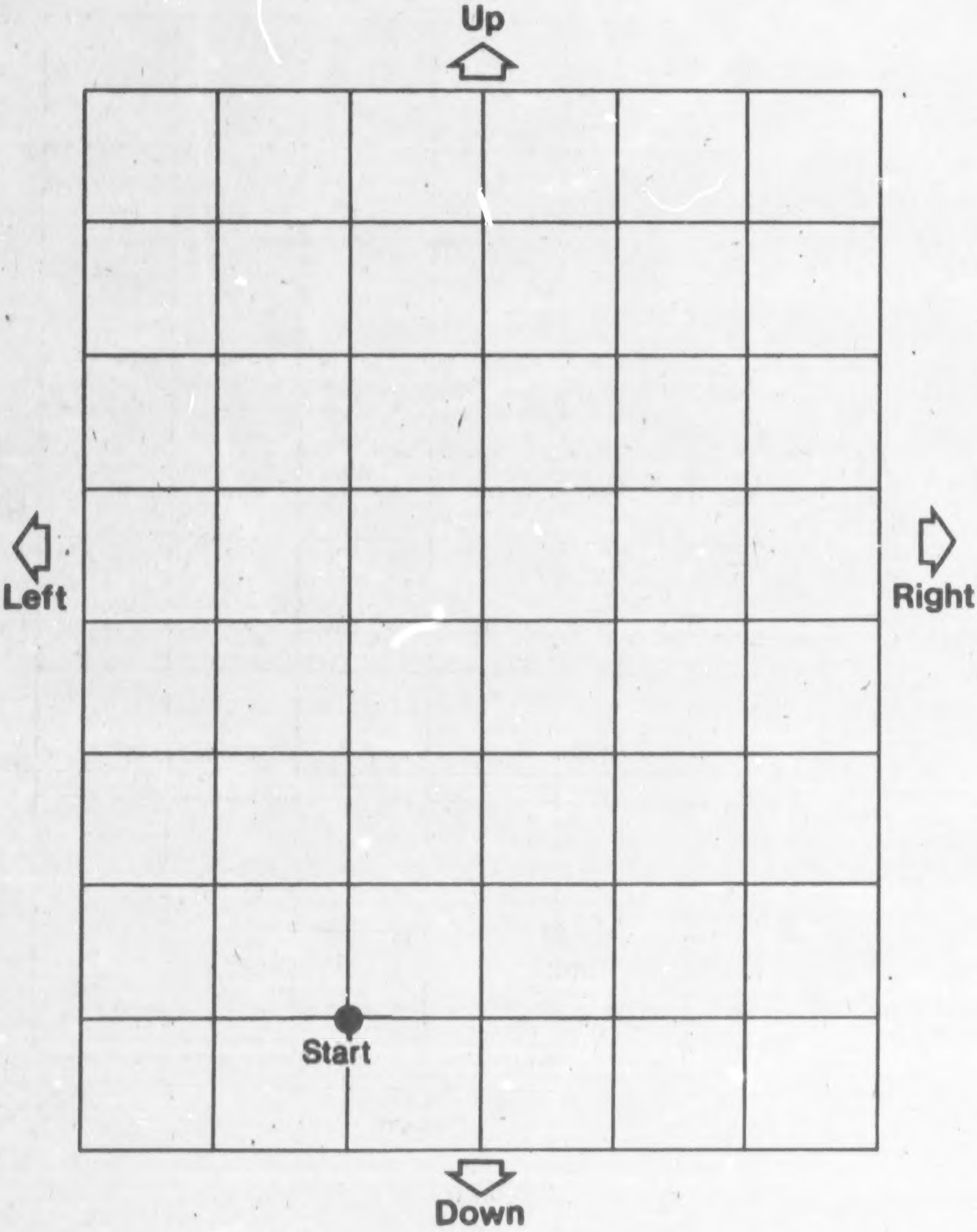
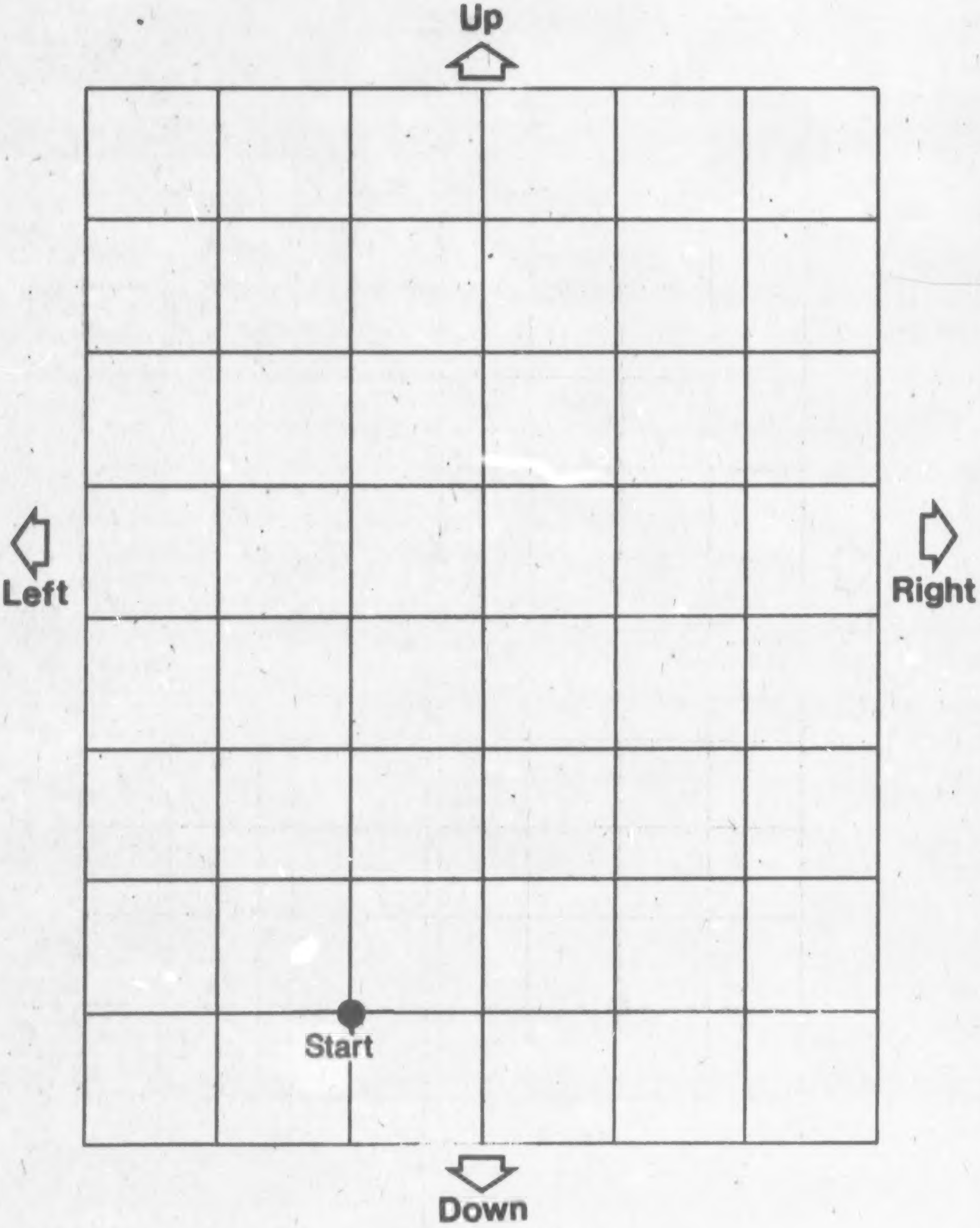
Name ______________________________

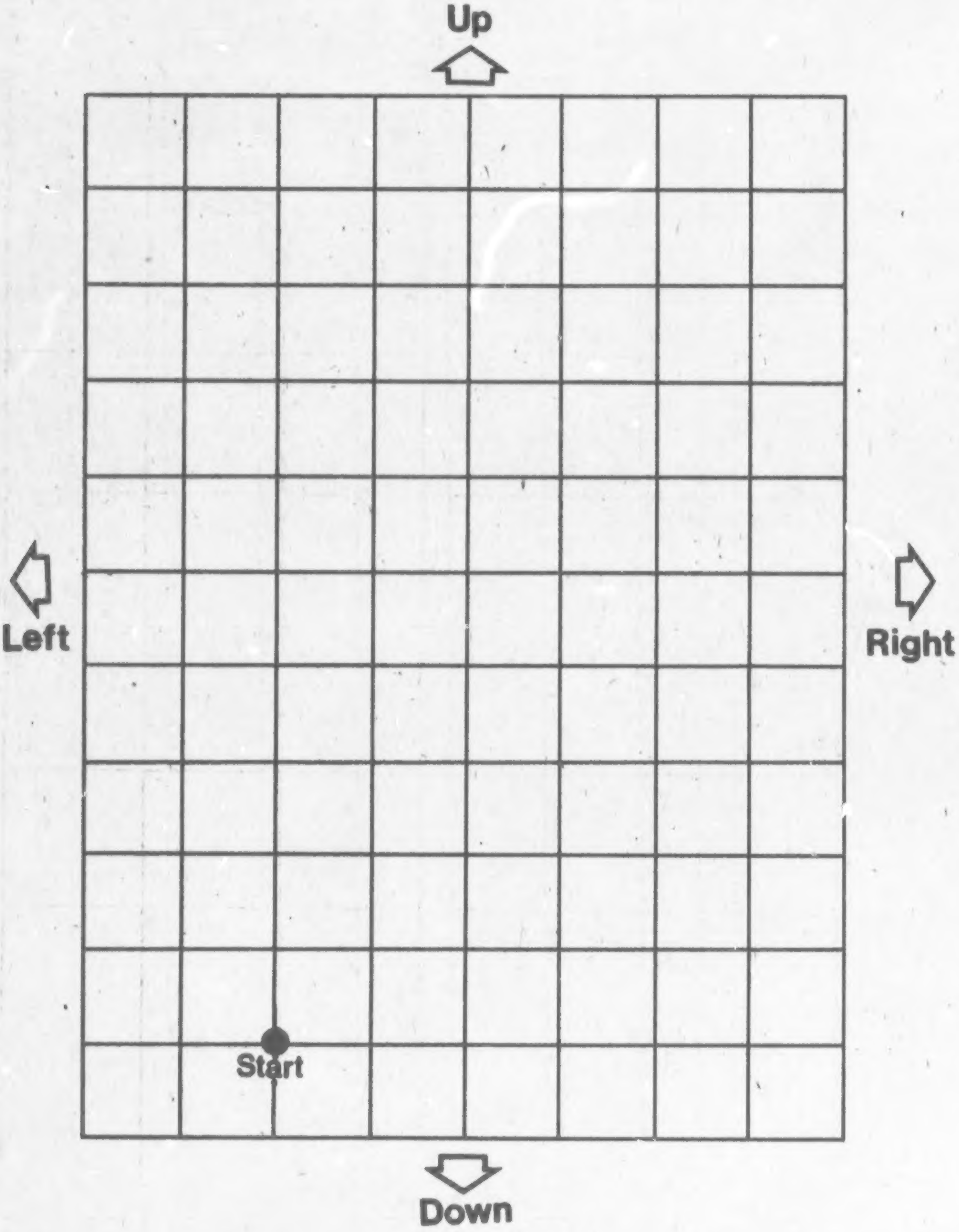
K63-I *

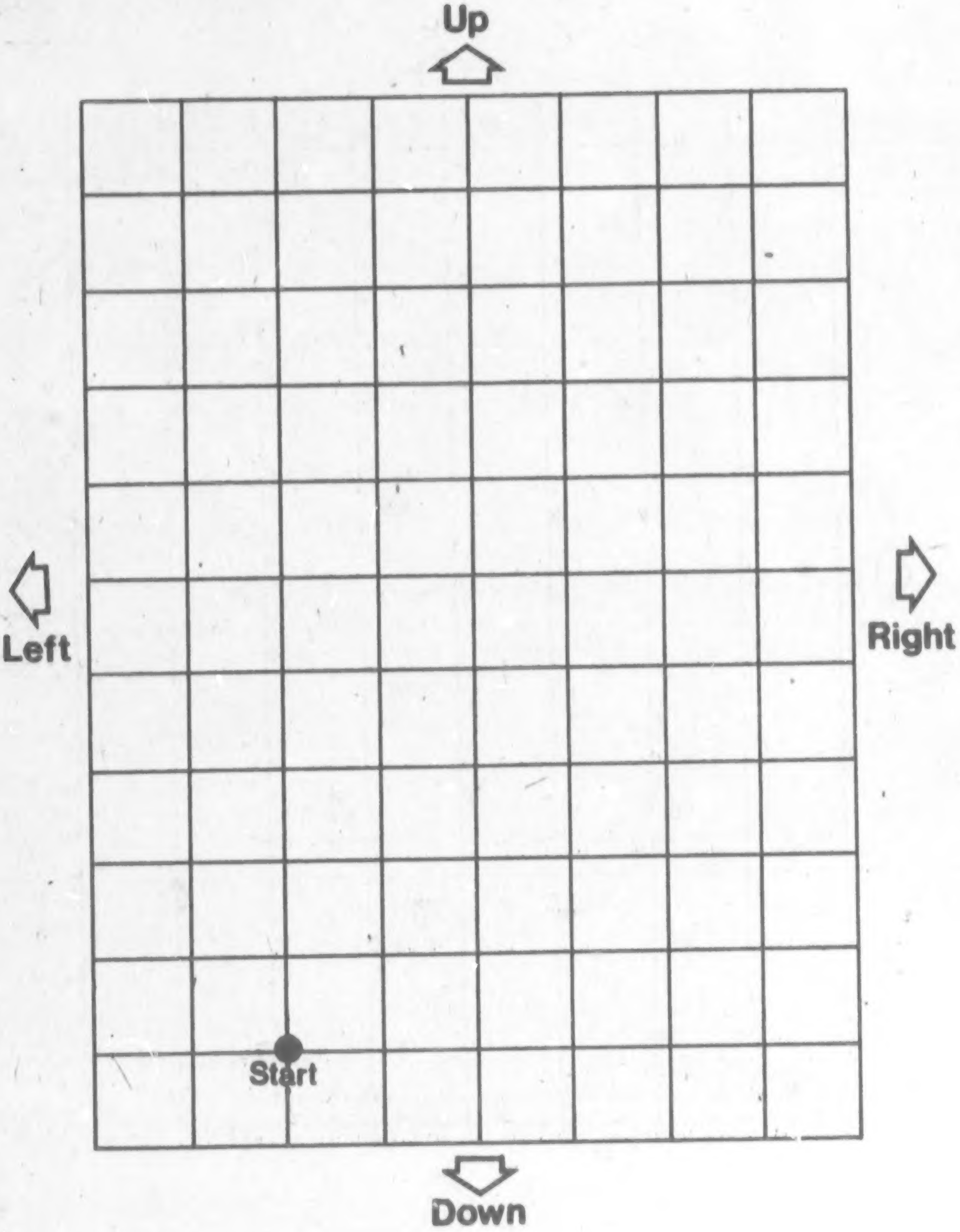

Up
Left
Right
Start
Down


Up
Left
Right
Start
Down

Name ______________________________

K63-II**


Up
Left
Right
Start
Down


Up
Left
Right
Start
Down

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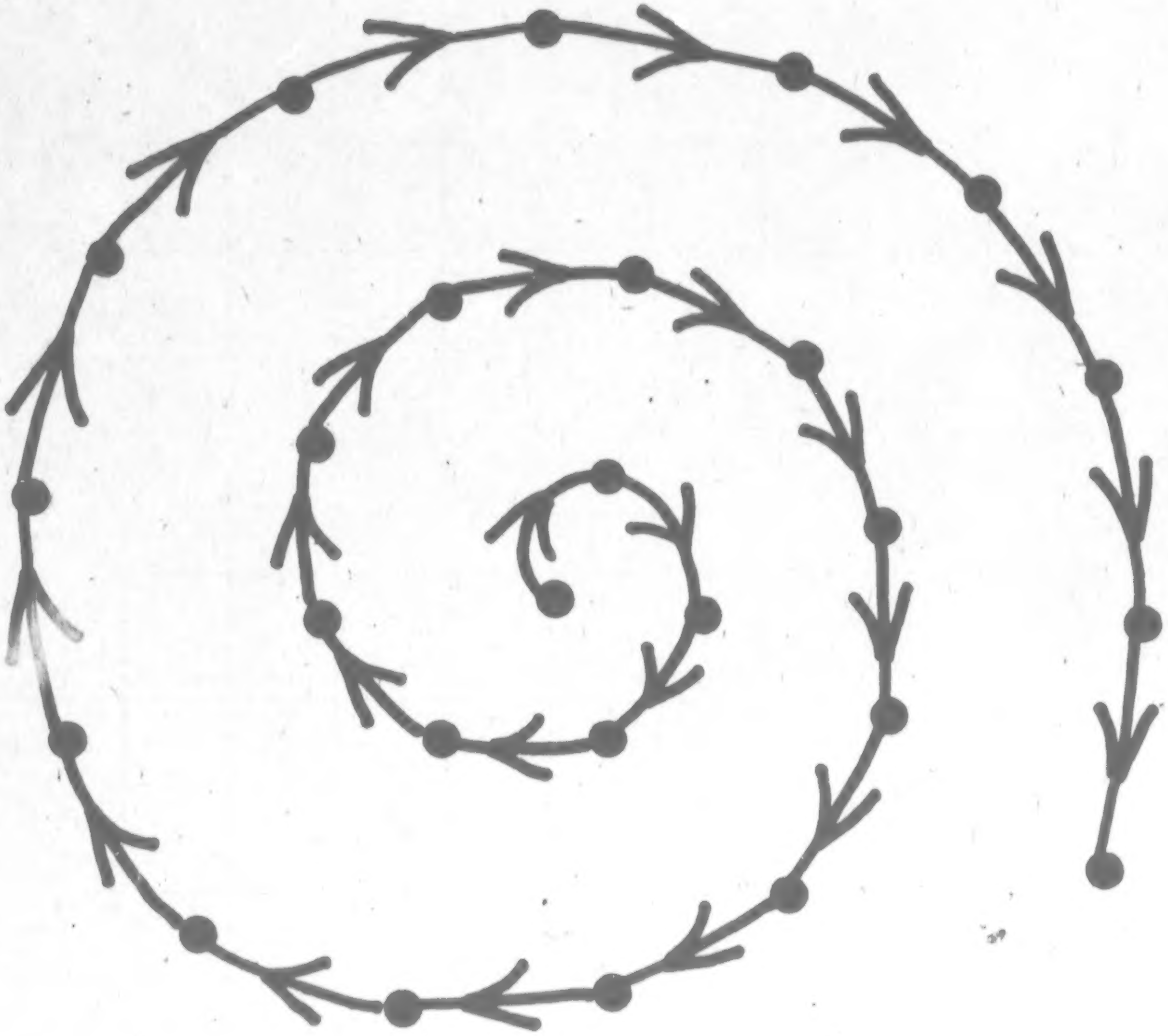
Name ________________________________

K 91 *

+1



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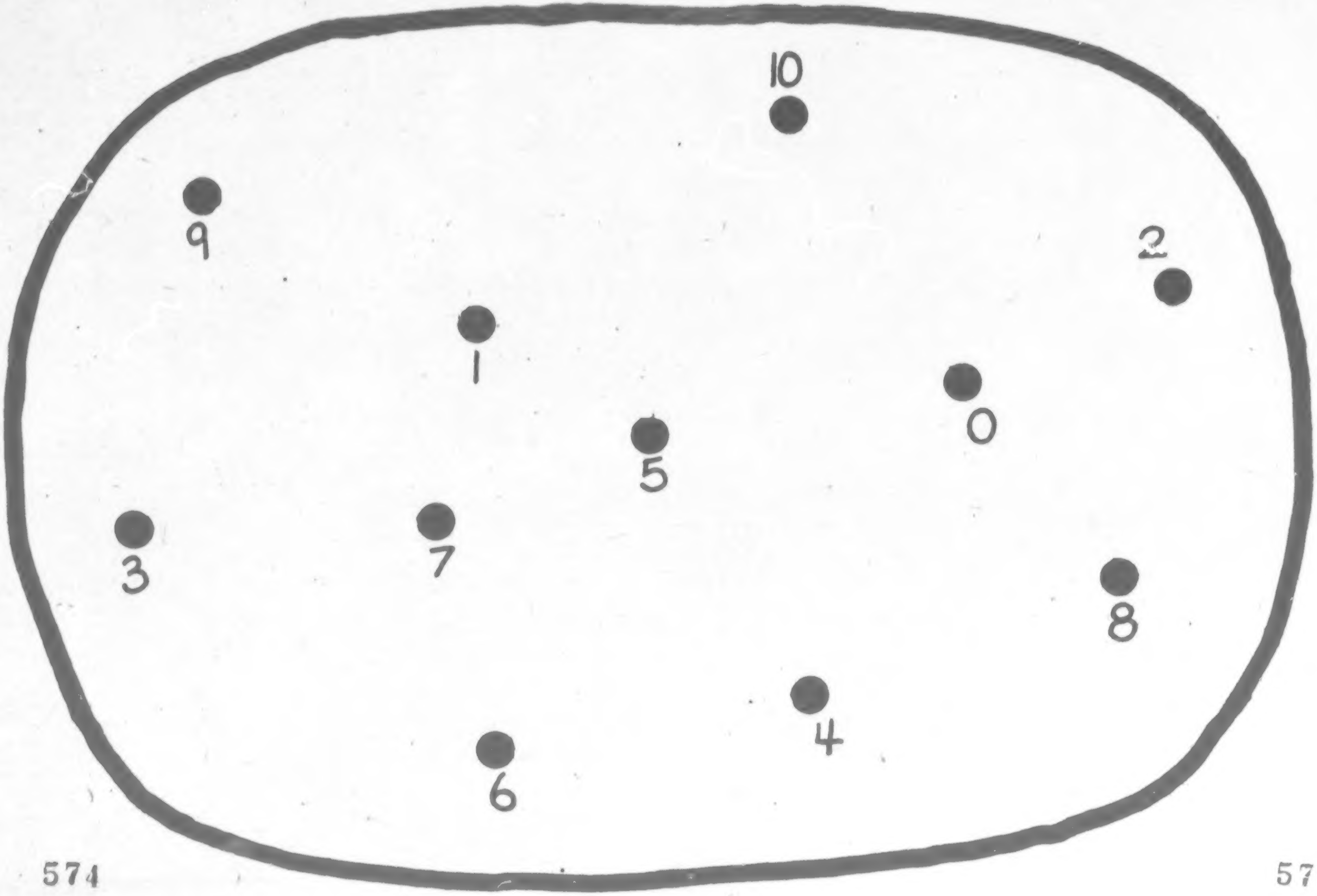
K 94 *

Name ______________________


10
9
2
1
0
5
3
7
8
4
6

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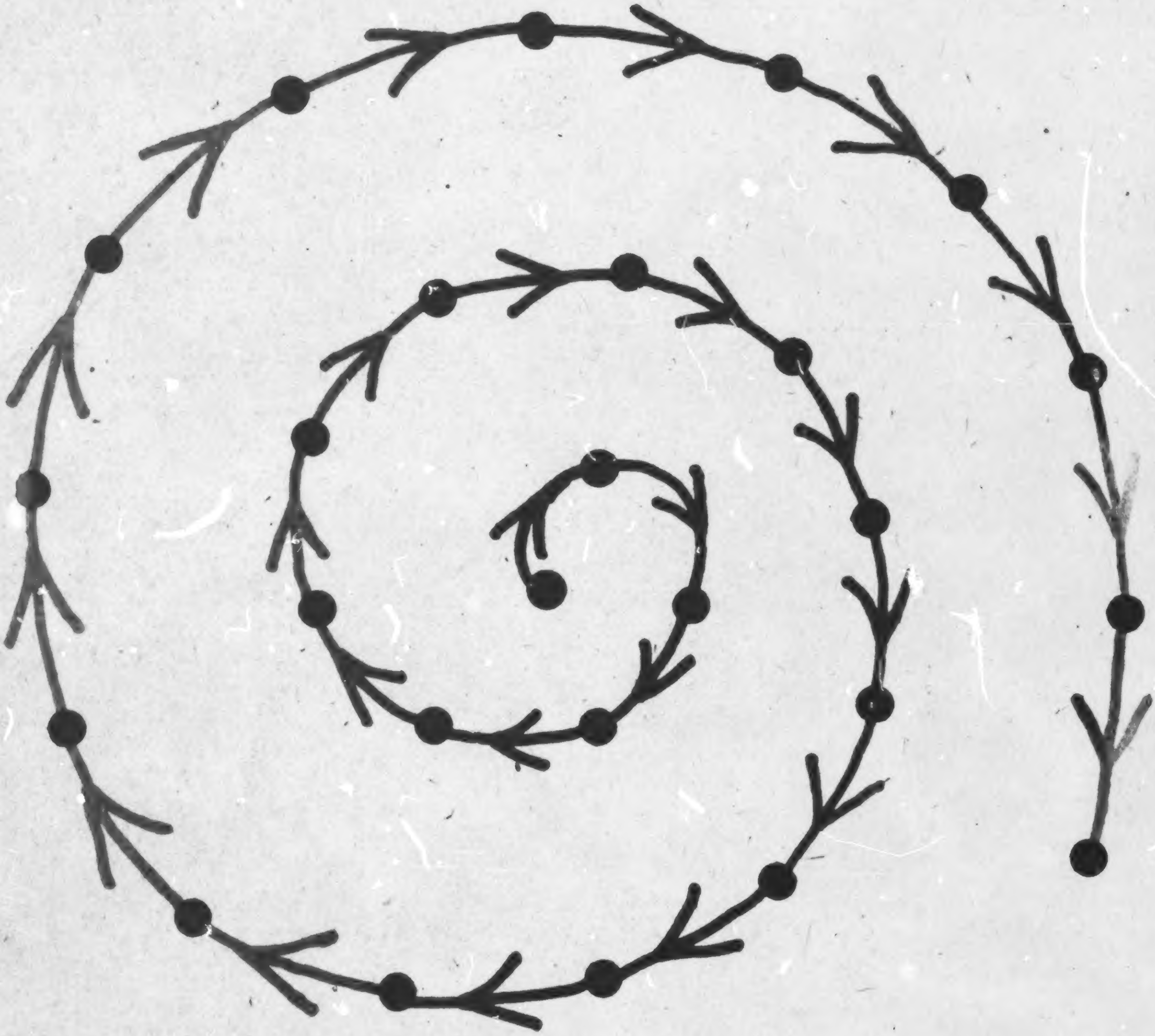
Name ______________________________

K 100 *

+2



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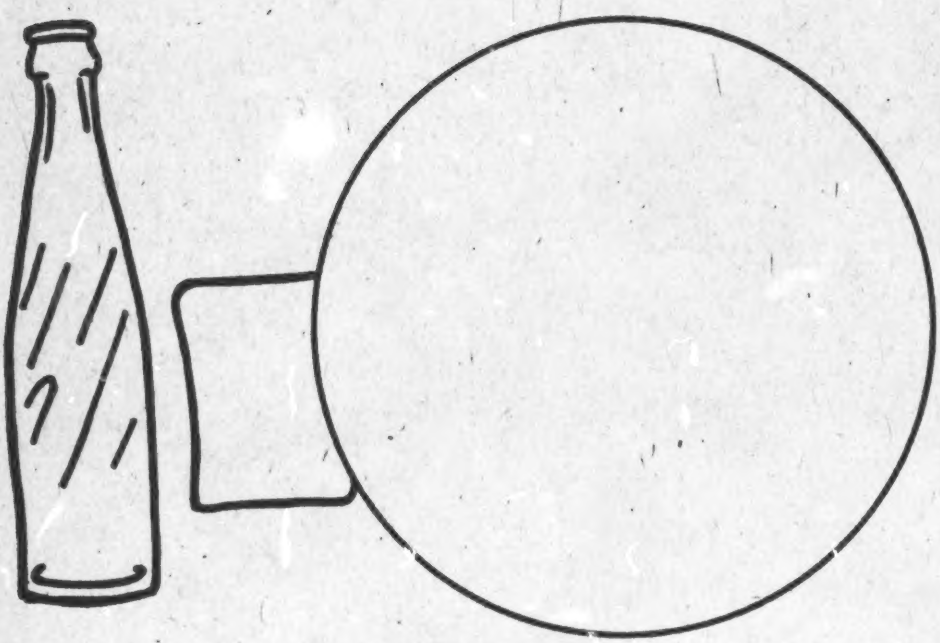
K 101 – I

Name ____________________



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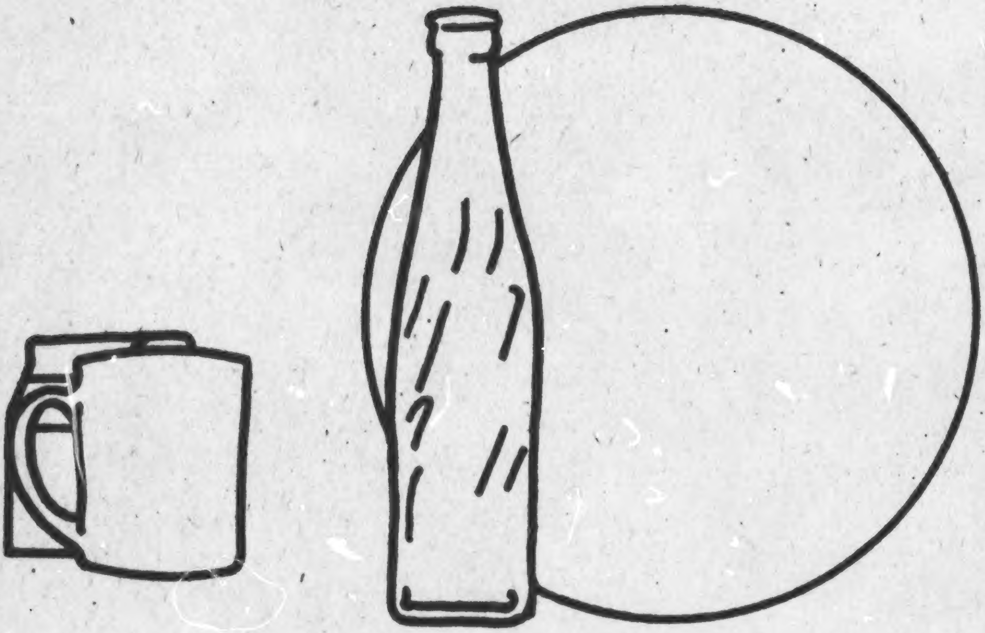
Name ______________________________

K 101–II



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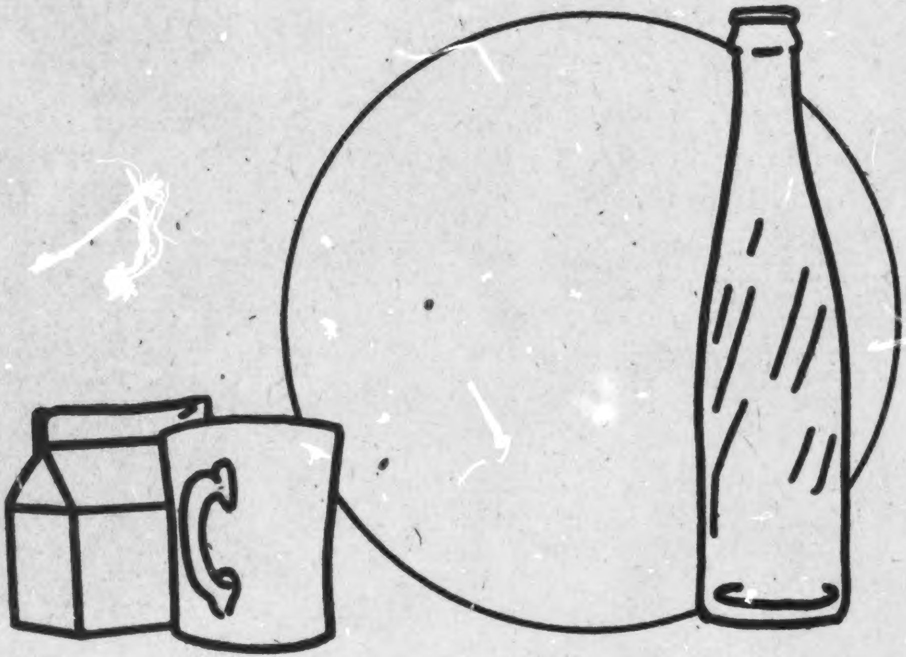
K101–III

Name ______________________________



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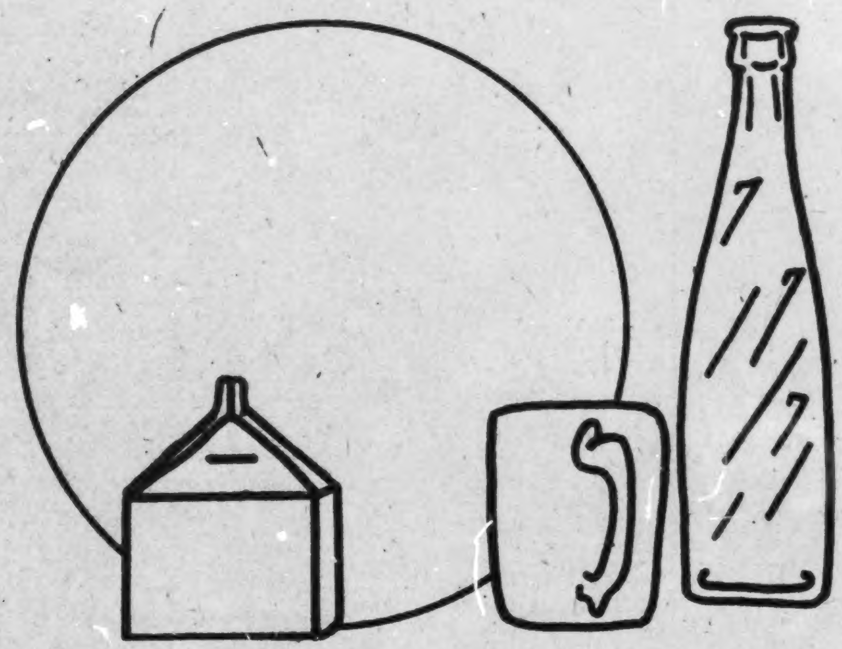
K 101-IV

Name ______________________________



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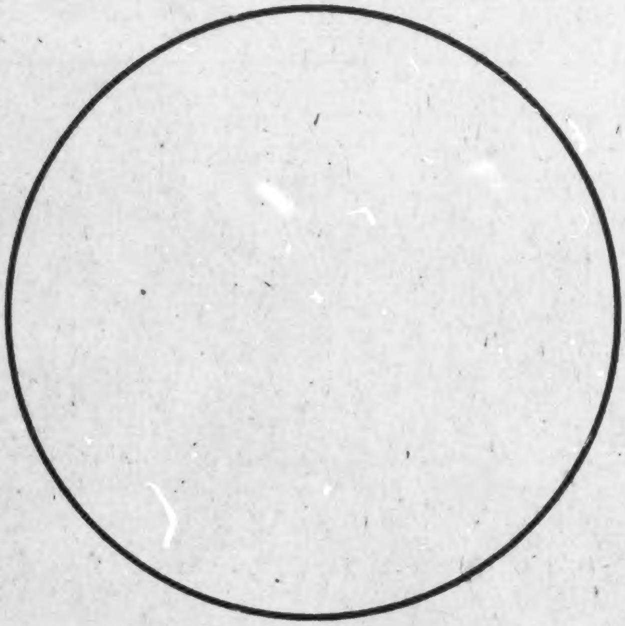
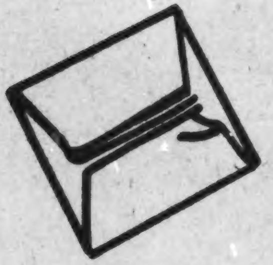
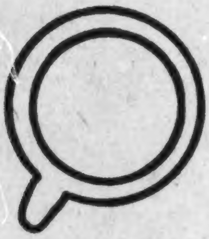
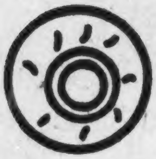
K 101 – V

Name ______________________________









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K 102–I *

Name ______________________________

In each row, write the numerals from 1 to 5.

●	●●	●●●	●●●●	●●●●●
1	2	3	4	5
1	2	3	4	5

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Name ______________________ **K 102–II ***

Each row should contain the numerals from 1 to 5. Complete each row.

1	2	3	4	5
1		3		5
	2		4	
1				

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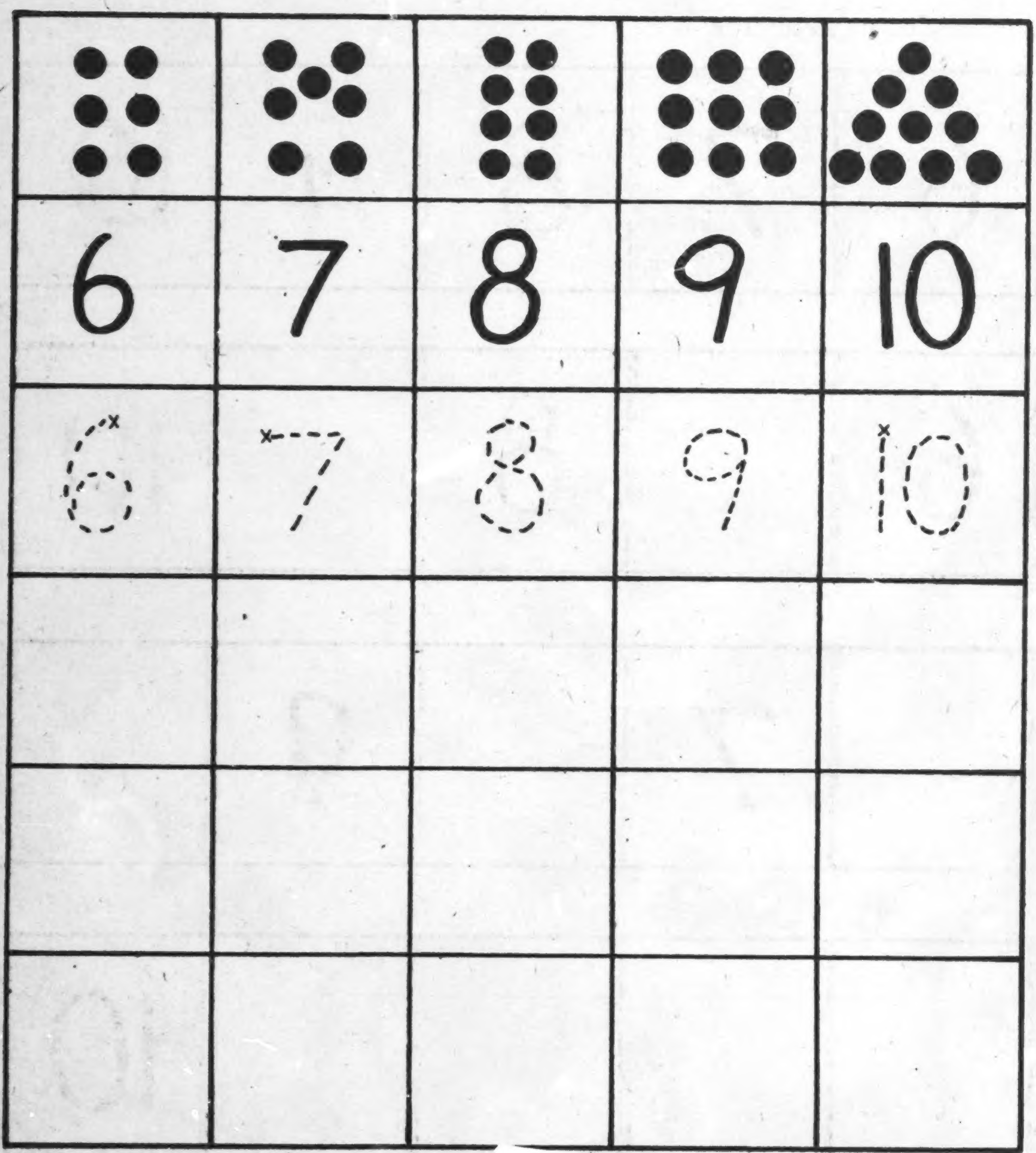
K102-III**

Name ______________________________

In each row, write the numerals from 6 to 10.


6
7
8
9
10
6
7
8
9
10

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K 102–IV***

Name ______________________________

Each row should contain the numerals from 6 to 10.

Complete each row.

6	7	8	9	10
6		8		10
	7		9	
				10

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K 102–V ***

Name ______________________________

Complete this 0 - 99 Numeral Chart.

0	1	2	3	4	5	6	7	8	9
10									
20									
30									
40									
50									
60									
70									
80									
90									

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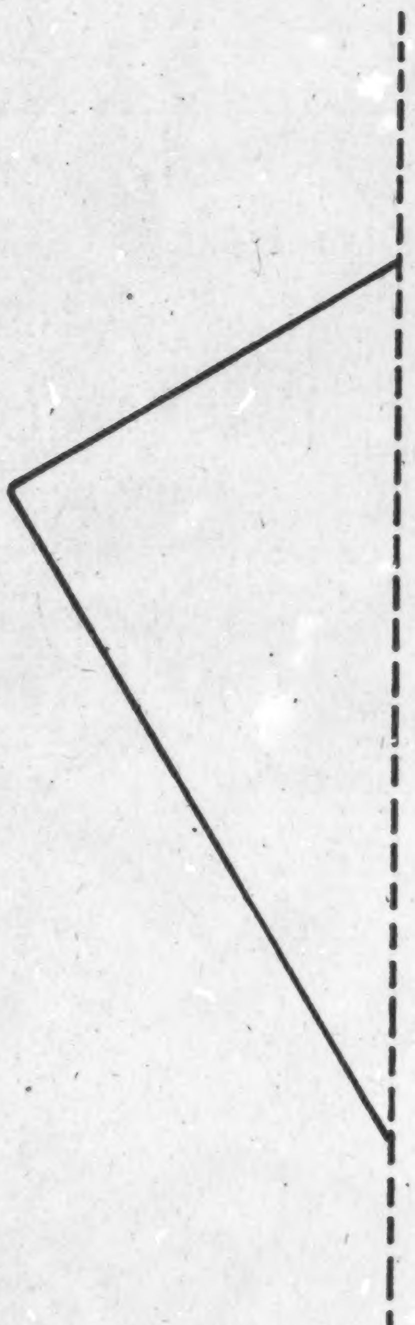
K105 - I *

Name ____________________



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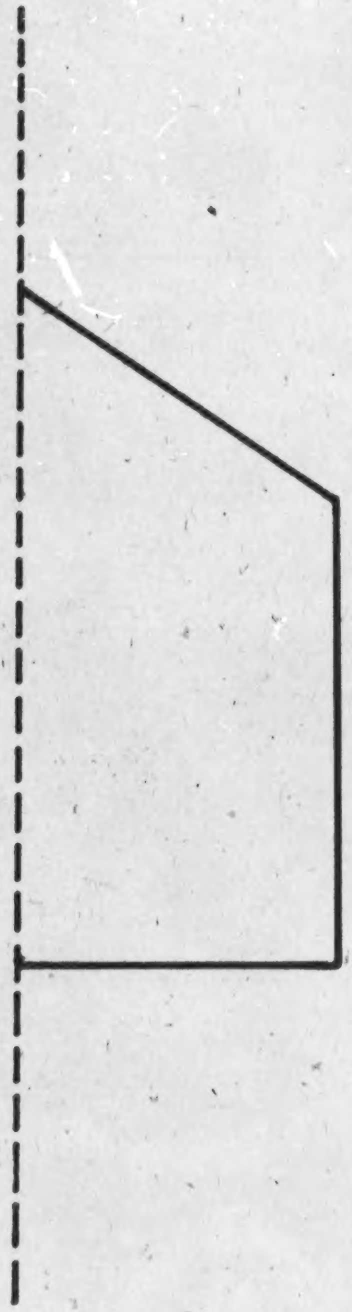
K 105-II *

Name ______________________________



Name ______________________________

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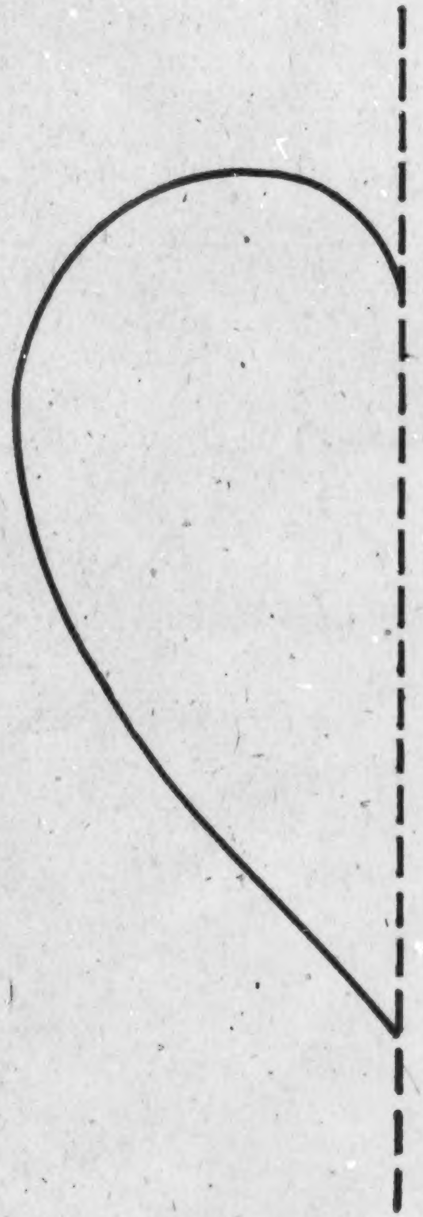
K105-III**



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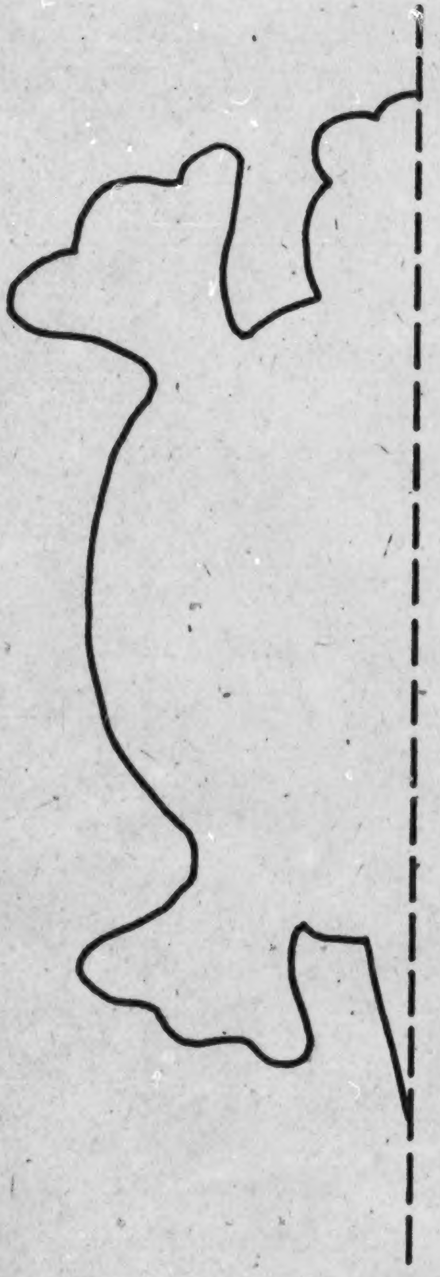
K 105–IV ***

Name ______________________________



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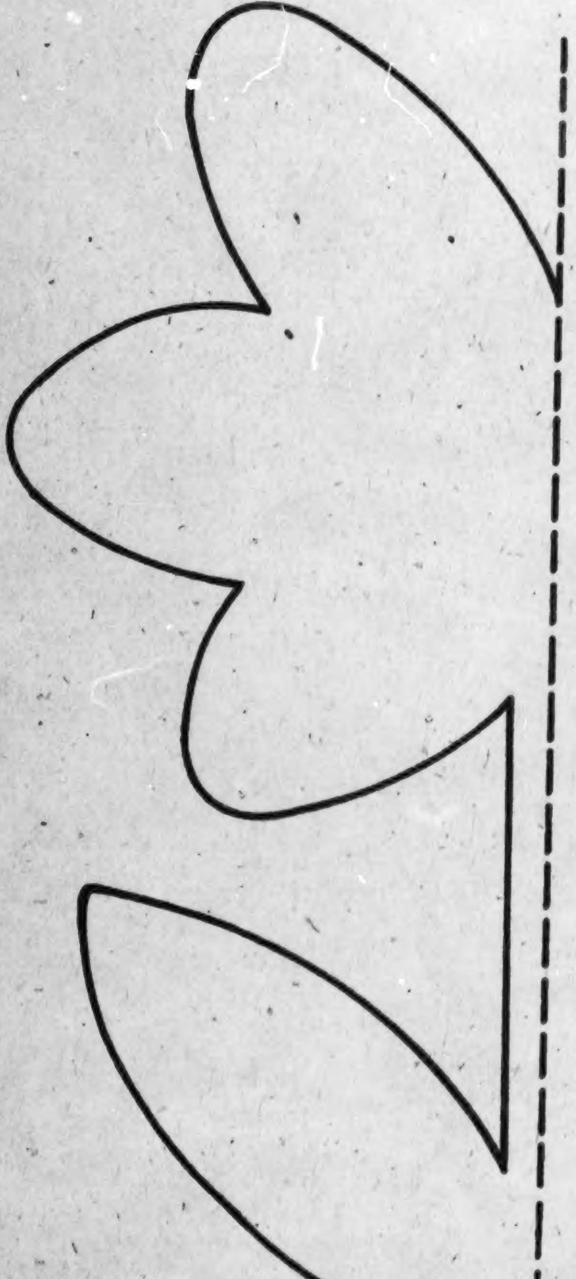
Name ______________________

K 105–V ***



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Name ______________________________

K-S1-I

●	1	1	1	1
● ●	2	2	2	2

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K-S1-II

Name ______________________________

● ● ●	3	3	3	3
● ● ● ●	4	4	4	4

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K-S1-III

Name ______________________________

● ● ● ● ●	5	5	5	5
● ● ● ● ● ●	6	6	6	6

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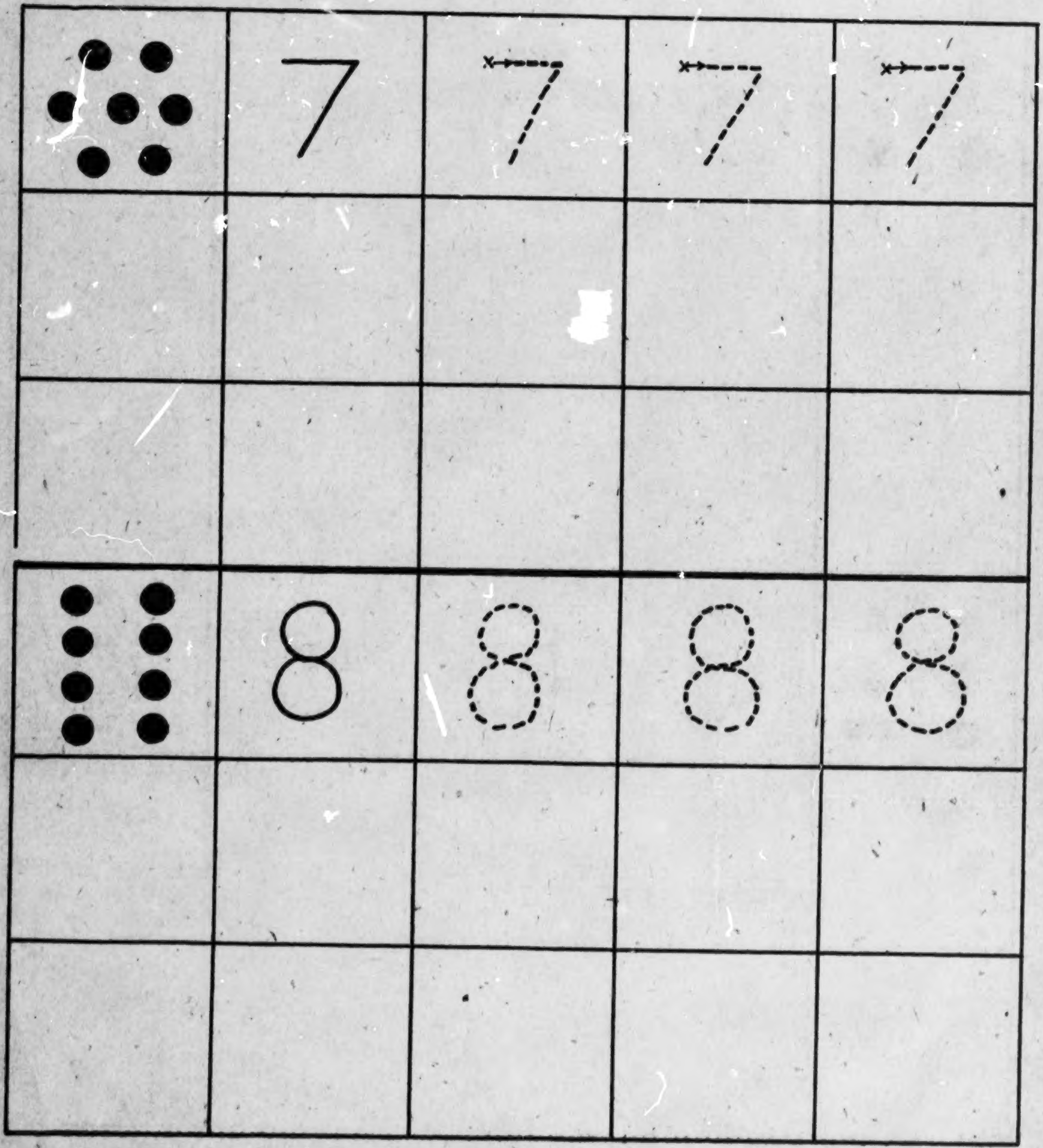
Name ______________________________

K-S1-IV



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Name ______________________________

K-S1-V

● ● ● ● ● ● ● ● ●	9	9	9	9
● ● ● ● ● ● ● ● ● ●	10	10	10	10